PAPERS AND ADDRESSES

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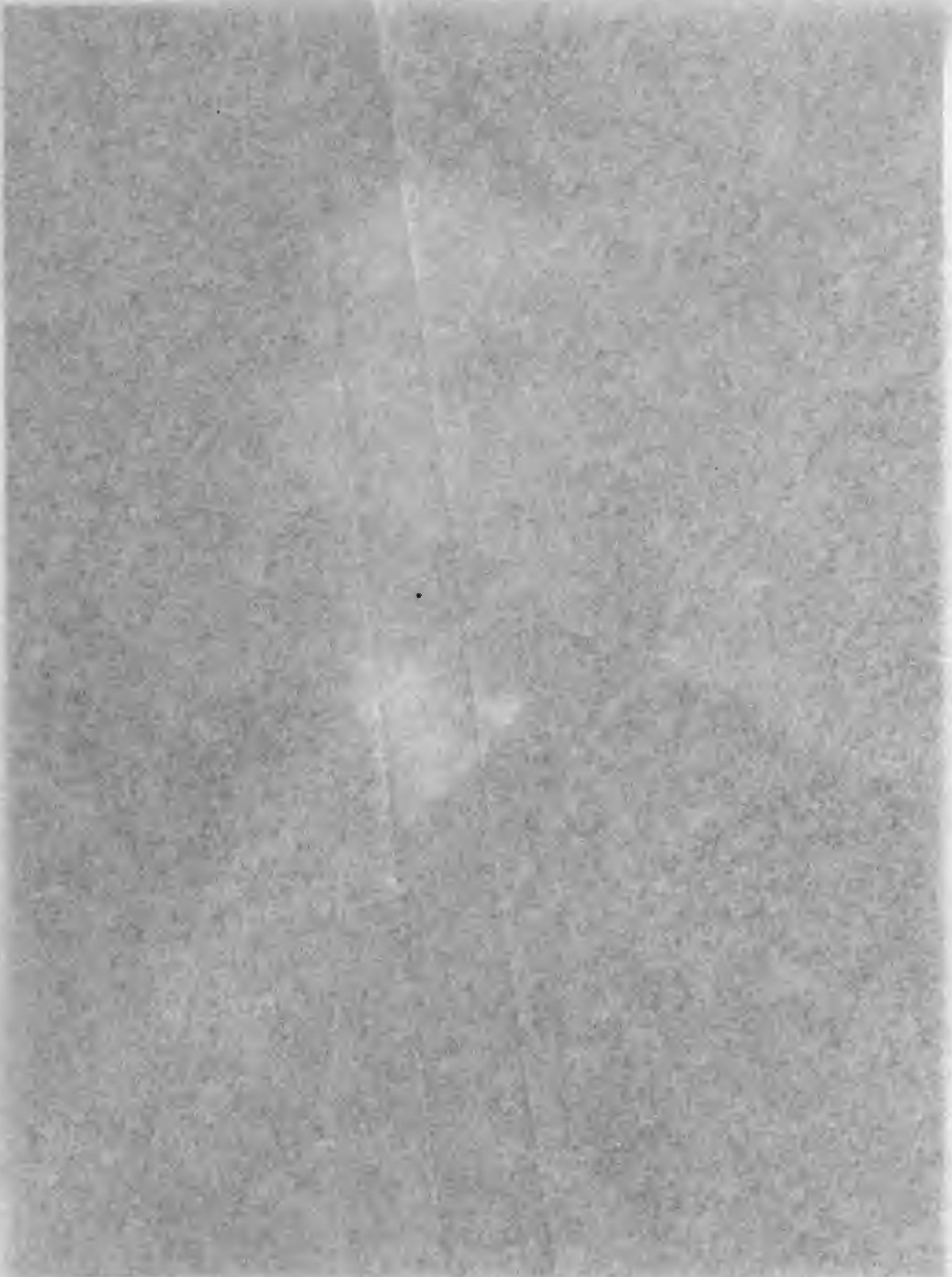

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WILLIAM HENRY WELCH

IN THREE VOLUMES

VOL. III

MEDICAL EDUCATION

HISTORY AND MISCELLANEOUS

VIVISECTION

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MEDICAL EDUCATION

ON SOME OF THE HUMANE ASPECTS OF MEDICAL SCIENCE[1]

Your attention will be called with just pride today to the achievements of this university during the first decade of its existence. Its contributions to letters and to science, its high standard of education and its usefulness in many directions are themes which are appropriate to the occasion. But in celebrating the past and the present we look forward with courage and enthusiasm to the future. For this future the subject which is now uppermost in the plans and the councils of the university is the establishment and the development of the medical department, in accordance with the conception of the munificent founder of the university and of the hospital. As the past ten years have witnessed the development of the philosophical department to its present position of high achievement and active usefulness, so it is hoped that the close of another decade will look back upon a similar record of good work and of progress in the medical department.

The higher purposes of medical education can be attained only by the establishment of well equipped laboratories and by the foundation of hospitals. For these, in a country where advanced education is dependent upon private benevolence, endowments are necessary. It is not a little remarkable that the first considerable bequest for the beneficent purposes of medical education in this country was made by the farsighted founder of this university, whose example in this respect has already been an inspiration for others to follow.

It is a wise provision that the medical department has been placed in organic connection with the other departments of the university; that it is coordinate with these. The relation which universities and medical schools should bear to each other has given rise to no little discussion in several of the universities of Europe, and the conclusion has been reached that for many reasons the interests of each are best subserved by making the medical school a department of the university, rather than by the foundation of independent schools of medicine. Besides the fact that certain branches of study belong equally to the philosophical and to the medical faculty, or are upon the border line between these, experience has shown that this connection conduces to greater solidity, to a more elevated tone, and to a broader and more enlightened system of medical education.

[1] An address delivered upon the occasion of the Tenth Anniversary of The Johns Hopkins University, Baltimore, April 26, 1886.
Johns Hopkins Univ. Circ., Balt., 1886, V, 101-103.

At the outset of this undertaking in this university it may serve a useful purpose to call to mind that the objects which are to be kept in view in the foundation of the medical department are humane, that their ultimate design is the relief of human suffering and the advancement of human welfare.

It cannot be doubted that the training of intelligent, competent and faithful physicians, whose life-work is devoted to the treatment of disease, is a benefaction to mankind. The means to be employed for this training have become much more elaborate than was formerly the case, and it is not impossible that the question might arise in the minds of some, whether, with all of these modern laboratories and appliances, and objects of study, the great aims of medical teaching, the knowledge and the treatment of disease, are not lost sight of. Such a doubt, if it exists, is without reasonable basis, as I shall attempt to show; the motive which suggests it, however, is to be respected, for it is true that the great objects of medical teaching are and always should remain the diagnosis, the prevention, and the treatment of disease.

The changes which have come about in the requirements of medical education are due, in great part, to the advancements in medical science. These advances have been all along the line. In anatomy and physiology, subjects which are the foundation of medical study, our knowledge of the structure and of the functions of the body in health has been widened, and in no small part as the result of work done in the biological laboratory of this university. Clinical medicine has profited by the introduction of more precise means for the discrimination of diseases, and by the addition of new remedies which are derived, in part, from the resources of synthetic chemistry. The finer changes of tissue and of function in disease have been the subject of much fruitful investigation during recent years. Of all modern discoveries in medical science, however, none have awakened greater interest or are of further reaching importance than those relating to the causation of disease. We have learned to recognize, in certain minute organisms, the specific causes of many of the most devastating diseases. These discoveries, which belong alike to the department of pathology, and to that of hygiene, have already had an important influence upon the management of disease, particularly in surgical practice. But it is in the prevention of diseases, especially of epidemic diseases, that this increasing knowledge of their causation is destined to do the most good. Although the prevention of disease is the highest aim of medical science, the cultivation of this branch of medicine is of comparatively recent date. The large medical schools of Europe have awakened only within the last few years to the importance of establishing hygienic laboratories, in which are investigated the causation of

diseases, the laws governing the origin and the spread of epidemics, the principles of ventilation, of heating, of sewerage, the influence of the air, of the ground, of the water in the production of certain diseases, in a word, all that pertains to the preservation of the health of communities and the warding off of preventable diseases. Investigations in these directions have already accomplished much toward the preservation of the public health. A notable instance of this is the great improvement in the healthfulness of the city of Munich, which has resulted from the introduction of important sanitary measures based upon investigations carried on in the magnificent Institute of Hygiene of the University. Munich in which formerly typhoid fever was present almost constantly in an epidemic form, has been freed from this scourge. It would not be difficult to show that in many other ways the advancements in medical science have contributed to the relief of disease, and have promoted the health and consequently the happiness of mankind. Here, however, is not the time nor the occasion to enter into details concerning the progress of medicine, or to discuss the practical applications of recent medical discoveries. My purpose is to emphasize the fact that the researches which are carried on in all of the different departments of medicine tend toward one common object, and this is a better understanding of diseases, as regards their nature, their causation, their discrimination from each other, and above all, as regards their prevention and treatment.

In order to attain this object it is necessary that the labor of investigation should be divided. The time has gone by when one mind can compass all which has been ascertained in the medical sciences. The division of labor has led to most fruitful results, and at the same time a superficial observer might come to the conclusion that the work in certain departments has little or no relation to the great practical objects of medical study. This, however, would be an error. He who studies the ultimate structure of a nerve fibre, or the law of contraction of a muscle is contributing just as truly to the furtherance of our knowledge of the diseases of nerve and of muscle as is he whose studies are directed more immediately to these latter subjects. The former investigator often furnishes the only solid basis upon which the latter can build his superstructure.

By this division of labor it has come about that there are those who cultivate each special subdivision in the medical sciences as an end in itself. There will be found those who are ready to devote years of patient study and of research to some one subject, no matter how narrow the field for investigation may seem or how remote the bearing of the subject upon practical medicine may at first glance appear. It is only by this concentration of energy that the best results can be obtained and the true interests of medi-

cal science most effectually advanced. The good work done in one department does not stand alone; it aids progress in other departments, often in ways which cannot be foreseen. The physician who ministers to disease at the bedside, and the sanitarian who institutes measures for the preservation of public health turn to advantage results obtained in laboratories by work which, in some of its stages, may seem to have been without direct application to practical medicine. There is, therefore, a community of interests and of ulterior purpose among all the workers in the field of medicine, among those who, relieved from the duties of practice, give their time to investigations in the laboratory and those who are actively engaged in the relief of disease.

The attractions of study and the pursuit of medicine have been greatly increased by the progress which has been made in the development of the different subdivisions of medical science. Many departments of medicine now possess the interest and the attractions of a natural science. Here will be found problems of absorbing interest, some of which call into requisition powers of acute observation, some demand for their solution ingenuity in the device of new methods and of apparatus, others require a profound knowledge of physics, or of chemistry, or of mathematics, and others call especially for well developed faculties of logical inference and of wide generalization. The rewards are great and of these the greatest is the consciousness that the work is for the advancement of the welfare of humanity in the preservation of health, the relief of suffering, and the promotion of happiness. What wonder, then, that a larger and larger number of those who have enjoyed the benefits of a liberal education are attracted to the study of medicine?

Experiment and observation of nature have taken place, in the medical as well as in other sciences, of deductive reasoning and appeal to authority. In former times medical teaching consisted chiefly in didactic lectures which originally were for the most part commentaries on the great medical writers of antiquity. Useful as didactic lectures may have been in mediaeval medical instruction, their value for the present time has been greatly lessened by the multiplication of good text-books in every department of medicine. With the decadence of the purely didactic lecture as the main feature in the system of medical education, the importance of laboratory instruction, of clinical teaching, and in general of demonstrative and objective methods of imparting knowledge has become better recognized.

There is no more striking illustration of the beneficent side of medicine than in the application of medical science to hospital work. In the construction of a properly planned hospital, application is made of the results of investigation in hygiene. It is believed that an unsurpassed example

of the application of the most approved principles of sanitary science to hospital construction will be found in The Johns Hopkins Hospital, which is destined to become an ornament and a splendid benefaction to this city. It is not necessary to dwell upon the benevolent use of such a hospital, pertinent as the subject is to my theme. It needs no statement to prove the inestimable boon which those who seek relief in well-managed hospitals find in the best medical and surgical attendance, in the trained nursing, in the provision of suitable diet, and in cleanly and health-bringing surroundings. Not the least of the blessings which may be expected from The Johns Hopkins Hospital is the education of trained nurses, whose ministrations will greatly increase the efficiency of the hospital. The occupation of a trained nurse has become a noble profession for women. The benefits to be derived from their services can be fully appreciated only by those who have had practical experience in their employment.

It may not be inappropriate in this connection to allude to the relations between medical teaching and the interests of patients in hospitals. I believe that considerable misconception exists concerning this subject. While it is generally admitted that in any course of medical education opportunity should be given for the study of disease in hospitals, nevertheless some believe that this must be a misfortune for the patient. I can state as a matter of observation and experience that by every right-minded physician the interests of patients in hospitals are placed foremost. The late Dr. Austin Flint, one of the greatest clinical teachers which this country has produced, expressed sentiments, from which there can be no dissent, in his advice to medical students, when he said, "Manifestations of indifference or harshness toward patients in charitable institutions deserve to be stigmatized as brutal. These patients have claims of poverty added to those arising from their diseases. Brutality is less reprehensible when manifested toward those whose influence is valuable, from whom fees are expected, and who can terminate at any moment professional relations with their medical advisers." These precepts embody the practice of one who made the fullest use for all legitimate purposes of abundant opportunities of clinical study and observation in hospitals. They are the precepts which govern the action of the great body of physicians who give their time and skill to needy patients in hospitals. Did time permit it could be shown that the benign use of hospitals for purposes of medical teaching are of reciprocal benefit and that the interests of patients, instead of being sacrificed, are thereby promoted.

But I have already reached the limit of time allotted to these remarks. There are many other phases of medical science in which its humane aspects might be dwelt upon. My purpose has been to call your attention only to those beneficent aims which suggest themselves most prominently in con-

nection with the organization of a medical school and hospital. The various departments of medical science require no defence, for they are in themselves legitimate objects of pursuit; but they acquire a higher interest and appeal more strongly to the cooperation of the public when it is made apparent that their aims are to serve the higher interests of humanity. When a great medical foundation rests upon private benevolence, it is particularly appropriate that these humane and noble purposes should be emphasized.

THE JOHNS HOPKINS MEDICAL SCHOOL[1]

On the twenty-second of last February, at the seventeenth anniversary of The Johns Hopkins University, President Gilman, in behalf of the Trustees, announced that The Johns Hopkins Medical School will be opened in October next. In his address on that occasion, he showed that the purpose of the founder of the university and hospital in providing for such a school as a part of the university and in association with the hospital had been kept in view since the beginning of the university, and had influenced the establishment and development of several departments of science in this university. It had been contemplated that the medical department would be fully organized at the time of the opening of the hospital, but when that time came financial difficulties rendered impossible the fulfillment of this long cherished purpose.

This apparently indefinite postponement of the opening of the medical school was the more keenly appreciated because enough had already been done to make clear that here was a great opportunity for medical education. The university had already provided professorships of chemistry, physiology and pathology; the hospital had secured a staff of able physicians and surgeons, who received from the university the title of professors; many details in construction of the hospital, which added much to its cost, were intended for the use of the medical school; in various ways the resources of these two great institutions, university and hospital, were available for the benefit of the medical school. Additional buildings, laboratories and professorships, however, were needed to complete the organization of a medical department worthy of the university. I need not rehearse how, by the generous gift of Miss Garrett, these difficulties were overcome. This was all told by President Gilman on last Commemoration Day.

It seems appropriate on this occasion to say a few words about what has already been done toward the organization of the medical school and about the aims of the school.

Much needed to be done to prepare for the opening of the school in October, and no time could be or was lost in beginning these preparations. One of the first things to engage the attention of the medical faculty was the determination of the amcunt and character of preliminary education to be required of students admitted to the medical school as candidates for the doctor's degree. This is, in my opinion, the most perplexing problem

[1] **An address delivered at the Graduating Exercises of The Johns Hopkins University, Baltimore, June 13, 1893.**

Balt., 1893, 6p., 8°.

concerning medical education, especially in this country. A few words will make the difficulties clear. At present in this country no medical school requires for admission knowledge approaching that necessary for entrance into the freshman class of a respectable college; many schools demand only the most elementary education, and some require no evidence of any preliminary education whatever. Foreign medical schools differ in this respect, but all in Europe have far more rigid requirements for admission than has any school in this country. In Germany, which in recent years has done more than any other country for the advancement of medical science, the student passes from the gymnasium to the university, where, at an average age of nineteen years, be begins the study of medicine with physics, chemistry and other subjects, which are included in this country in the so-called preliminary medical courses. It is to be noted that training at a classical gymnasium is required and cannot be substituted by that at a real-gymnasium, in which a scientific takes the place of a classical course.

For many years in Germany and elsewhere there has been much discussion as to the preliminary education which should be required of students of medicine and there is still great difference of opinion on this subject. In his earlier years Du Bois Reymond said "Greek by all means should be required"; later he cried "More Conic Sections and less Greek." Virchow in his recent rectorate address demands an improvement in methods, especially in such as train the senses, particularly of sight and touch. "At present," he says, "we must complain that the majority of our students have no accurate knowledge of colors, that they make false statements regarding the form of objects which they see, and that they have no sense for the consistence and characters of the surface of bodies," and yet "knowledge of this kind is of the greatest importance for the medical man as often the diagnosis of the most important conditions depends upon it."

Even if there were agreement of opinion as to the best education preparatory for the study of medicine, there would still remain for us very serious and important difficulties peculiar to the system of education in this country. These difficulties result from the anomalous development of those American colleges which are half college and half university, but are neither one thing nor the other, and from which students are graduated at an average age of twenty-two to twenty-three years. The flower of our youth seek a collegiate education and it is eminently desirable that they should have it. We believe that those who have had a liberal education are best fitted for the study of medicine, but it is important that the study of medicine should begin at an age not exceeding twenty or at the utmost twenty-one years. The period of professional study should not be less than four years, and after this many will wish to spend a year or a year and a half in hospital service and an equal length of time in special study in this country or in Europe.

How are we to adapt to the embarrassing and anomalous development of American colleges a system of medical education for which a liberal education is demanded as a prerequisite? We are not prepared to recognize a high school training as sufficient, and between this and training in a college or scientific school there is no intermediate grade. We must therefore endeavor to conform to the peculiar conditions in our colleges and scientific schools. We do not claim to furnish an entirely satisfactory solution of the problem, but we have endeavored to do the best we could under all of the circumstances by asking that students who are admitted to the medical school as candidates for the doctor's degree shall possess the liberal education implied by a degree in arts or in science, and shall also have a specified amount of knowledge in certain sciences fundamental to the study of medicine as well as a reading knowledge of French and German. In other words we ask the colleges which keep students two years after the age when the study of medicine should begin, to teach them during these two years such subjects as physics, chemistry and general biology, which in most European schools are included in the medical curriculum, but which can be better taught in the faculty of arts, or of science, than in a medical school. This means that a student taking a four years' academic course in one of these colleges shall have made up his mind at the end of sophomore year to study medicine. It means also that, if compared with European systems of medical education, the course of medical study required for our degree of Doctor of Medicine covers five to six years. We fully realize that the number of students who will meet these rigid requirements is not likely to be large.

I have dwelt thus upon the requirements in education preliminary to the study of medicine, not for the purpose of discussing these requirements for which neither time permits nor is the occasion suitable, but in order to make clear that there are special difficulties in determining what these requirements should be and that these difficulties are greater in this country than elsewhere. Only experience can determine whether or not the plan which we have adopted is the best one for our purpose. It is to be expected and desired that, with improvements in educational methods and systems in this country, there will be corresponding improvements in the character of the training to be required in preparation for the study of medicine. At any rate we can feel sure that we shall not be subject to the reproach most frequently brought against American medical schools, viz.: a low standard of admission,—for our standard is not only vastly higher than has ever before been attempted in this country, but is not surpassed in any medical school in the world.

Before opening the medical department it was necessary to fill three professorships, viz.: those of anatomy, of pharmacology and of physiology. The trustees confirmed the appointment of the three men recommended

for these chairs by the Medical Faculty. Dr. Mall has accepted the professorship of anatomy, Dr. Abel that of pharmacology and Dr. Howell that of physiology. We believe that we have been most fortunate in securing these young men, who are enthusiastic and well trained in their special departments, and who have shown distinguished ability both as teachers and investigators. Each relinquished, in order to come here, important professorships with brilliant prospects in other institutions: Dr. Mall in the University of Chicago, Dr. Abel in the University of Michigan, and Dr. Howell at Harvard. It is a source of no slight gratification that these three new professors were all formerly connected with this university—Dr. Mall as fellow and assistant in pathology, Dr. Abel as a graduate student, and Dr. Howell first as student and ultimately as associate professor of physiology.

By Dr. Martin's resignation of the professorship of biology, we have been deprived of his aid in the organization of the medical school. He had formed a part of the small nucleus of a medical faculty which had existed in the university for many years. He had looked forward for years to helping to start the new school from which so much was expected. It was largely by his scientific work in this university that The Johns Hopkins Medical School had a distinguished reputation before it really existed. He has done a great work not for this university alone, but for the whole country, in the advancement of higher physiology; and the medical school should not and will not forget Dr. Martin's services in lighting here the flame of one of the chief medical sciences. That this flame will be kept bright by his successor in the chair of physiology, we all believe.

At present the pathological building on the grounds of The Johns Hopkins Hospital is receiving two additional stories, which will accommodate the departments of anatomy and physiological chemistry until other buildings of the medical school are constructed.

The length of time required to complete the course of study in the medical school will be four years. The first year will be devoted chiefly to the study of anatomy, physiology and physiological chemistry. At the end of this year the student will have reached about that point in the course which corresponds to the *examen physicum* in the German universities. With us, however, there will follow three years of strictly professional, mostly practical, study, instead of two years of such study in the German system. Pathology, pharmacology and the general principles of medicine and surgery will be taken up in the second year, and during the last two years the work will be very largely clinical, that is bed-side and dispensary instruction. At present only the details of the first year's course have been worked out and announced, as students at the beginning will be admitted only to the first year of study.

In the methods of instruction especial emphasis will be laid upon practical work in the laboratories and dissecting room and at the bedside. There will be close personal contact between teacher and student. Graduates of the school may look forward to securing places as internes in the hospital.

The aim of the school will be primarily to train practitioners of medicine and surgery, that is to qualify persons to take care of diseased and injured conditions of the human body. We hold that the medical art should rest upon a thorough training in the medical sciences, and that, other things being equal, he is the best practitioner who has this thorough training. The medical sciences have made great progress in the last quarter of a century, greater than has the practice of medicine with which alone the general public has much concern. The prevention and treatment of disease have, however, also made important advances, and it cannot be doubted that they will derive still greater benefits in the future from the discoveries which have been made and are to come in physiology and pathology.

But medical education is not completed at the medical school; it is only begun. Hence it is not only or chiefly the quantity of knowledge which the student takes with him from the school which will help him in his future work; it is also the quality of mind, the methods of work, the disciplined habit of correct reasoning, the way of looking at medical problems.

In order to cultivate in the student this habit of thought, this method of work, I believe that there is no one thing so essential as that the teacher should be also an investigator and should be capable of imparting something of the spirit of investigation to the student. The medical school should be a place where medicine is not only taught but also studied. It should do its part to advance medical science and art by encouraging original work, and by selecting as its teachers those who have the training and capacity for such work. In no other department of natural science are to be found problems awaiting solution more attractive, more significant than those in medicine; and certainly these problems do not lose in dignity because they relate to the physical well-being of mankind.

The Johns Hopkins Medical School will start unhampered by traditions and free to work out its own salvation. It will derive inestimable advantage from being an integral and coordinate part of this great university, which will see to it that university ideals and methods are not lost sight of in the new school. It will have the support of a great hospital, the trustees of which have already shown the most enlightened spirit in the encouragement of medical research. May The Johns Hopkins Medical School not only receive lustre from the university and the hospital, but may it also add to the renown and usefulness of both these institutions, of which it is to form a part.

REMARKS AT THE PRESENTATION OF THE CANDIDATES FOR THE DEGREE OF DOCTOR OF MEDICINE AT THE COMMENCEMENT OF THE JOHNS HOPKINS UNIVERSITY, JUNE 14, 1898[1]

Mr. President, Gentlemen of the Board of Trustees, Ladies and Gentlemen.—As this is only the second class to receive the degree of Doctor of Medicine from this university, it will not be inappropriate, before presenting the candidates for the degree, to say a few words concerning the development and aims of the recently organized medical department of the university.

Through the munificent gift of Miss Mary Elizabeth Garrett, added to a smaller but generous contribution from other public-spirited women, and supplementing the available resources of the university and hospital, the trustees of the university were enabled to open the medical department for the instruction of men and women on the second of October, 1893. At two previous commencement exercises the opportunity has been afforded me to present in some detail the plan of organization and the purposes of the new medical school, and it is not necessary to repeat what was then said.

We began five years ago with only the first year of the course organized, with a teaching staff of fifteen, and with an entering class of students numbering eighteen. A year from last October the organization of the entire four years' course was completed, and last June we graduated our first class of fifteen students. During the academic year now closing 167 students have been enrolled as candidates for the degree of Doctor of Medicine, 26 in the fourth year, 34 in the third, 44 in the second, and 63 in the first. All of these are college graduates, and before admission spent a year or more in the study of chemistry, physics and biology. In addition, 69 physicians have been in attendance upon special courses or have engaged in research, making a total attendance of 236. The teaching staff numbers 53, of whom 21 are professors, clinical professors or associate professors. The steady growth of the medical department with each succeeding year has, therefore, been most gratifying and has laid to rest the fears, which some at first entertained, that our high standard of admission, necessitating not only a degree in arts or science, but also a good practical training in physics,

[1] An address delivered at the Commencement of The Johns Hopkins University, Baltimore, June 14, 1898.

Johns Hopkins Hosp. Bull., Balt., 1898, IX, 151-154.

chemistry and biology, with a reading knowledge of French and German, and acquaintance with Latin, would restrict unduly the number of students.

Not less significant is the national character of this medical school as shown by the distribution of the students among the several states. Thirty are credited to Maryland, but of these a number have made this their home only since entrance into the school. Of the remainder, 32 come from New England, 22 from the Middle States, 27 from the Southern, 38 from the Middle West or Central States, 13 from the West (11 being from California), and 5 from Canada, Hawaii and India.

Forty-seven colleges are represented, The Johns Hopkins University by 31 students, Yale by 29, Harvard and the University of Wisconsin by 9 each, Wellesley and Smith by 7 each, the Leland Stanford Jr. University and the University of California by 6 each, and Princeton, Williams, Amherst, Vassar, Cornell, the University of Chicago and other colleges by smaller numbers.

But more significant than the growth of the school in numbers or the wide area from which our students are drawn are the contributions to the advancement of medical education in this country which we may fairly claim to have made. The mere addition of a new medical school to an already overburdened list can hardly be regarded as a meritorious act. We have realized from the start that unless we had something to contribute to the promotion of medical education and knowledge, there was no reason for our existence. No one familiar with the conditions of medical education in this country could fail to see that the opportunity existed to do for medical education what this university has accomplished for university education in this country. With the inspiration of such an example and with these high ideals before us, what better place could be found for such a work than in this university and in the city of Baltimore? It would occupy too much time on this occasion to enter into details upon this subject, but concerning two or three of the more distinctive features of this medical school I shall ask permission to say a few words.

We have raised the requirement as to the training preliminary to the study of medicine to a point not only beyond that of any other medical school in this country, which in view of the former low demands in this respect might not signify much, but to one equal to, if not in advance of, that of any foreign university. This high standard of admission, instead of proving a weakness, has been one of the main sources of our strength. It has secured for us students whose average fitness for the study and practice of medicine is unquestionably greater than has been hitherto attained in our medical schools, and it has brought to us not a few of unusual capacity and promise. Students are attracted to an institution where their associations are wholly

with liberally educated classmates, and the resulting tone and morale of the school are elevated, in welcome contrast to the traditional conception of the social and moral atmosphere of a medical school. It is evident that far better methods of teaching and better results can be secured with highly trained students than with those without adequate preparation.

While we designate our required period of medical study as four years, it is in reality from five to six years, for we relegate to the period of preliminary collegiate training the study of general chemistry, physics and biology, which are included in the medical curriculum of many schools, especially in Europe. The study of these sciences, which is justly considered to be an essential part of a thorough medical education, can be pursued to greater advantage in a college or university than in a medical school, and the arrangement which we have adopted adjusts itself readily to the existing conditions in our best colleges and universities.

Coming to us with this exceptional training, our students have a right to expect exceptional advantages for the study of the profession which they have chosen, and, so far as our resources permit, we have endeavored not to disappoint them in this respect. The aim of the school is primarily to train practitioners well grounded in the fundamental medical sciences and in practical medicine and surgery and their branches. We have broken completely with the old idea that reading books and listening to lectures is an adequate training for those who are to assume the responsible duties of practitioners of medicine. Anatomy, physiology, physiological chemistry, pathology, bacteriology, pharmacology and toxicology are taught during the first two years by practical work in the laboratory, and in the last two years disease is studied in the dispensary and at the bedside, not merely as it is described in books.

At the beginning we had only one laboratory building; in 1894 we were provided with a second commodious building, the Women's Fund Memorial building, intended for the various anatomical sciences; in 1896, through a generous gift to the hospital, we were enabled to construct the clinical laboratory, and in the coming autumn a still larger building, now in process of erection, will be ready for the laboratories of physiology, physiological chemistry and pharmacology. We shall then be well equipped with the needed laboratories, which constitute the workshops of our students during the first two years of the course.

From these laboratories the students pass at the beginning of the third year directly to the dispensary and the wards of the hospital, where our arrangements to enable them to become practically familiar with the symptoms, the diagnosis and the treatment of disease constitute perhaps our most original and valuable contribution to the methods of teaching practical

medicine. The generous cooperation of the trustees of The Johns Hopkins Hospital, in accordance with the wishes of its founder, in rendering available for the instruction of students the resources of this great institution, has placed it in our power to make the years devoted to the training in the practical branches of medicine and surgery peculiarly attractive and efficient. They also provide for a large number of our graduates, as well as to others, opportunities to serve as internes in the hospital.

The advantages of thus coming throughout the entire course into direct personal contact with the objects of study are not merely that the students thereby acquire a more useful and living knowledge of them, but that they become familiar with scientific methods and acquire something of the scientific spirit of investigation and of approaching medical problems. They should thus be enabled by their subsequent observations and experience to carry on an education, only begun at the medical school, and which should continue throughout their professional lives.

To obtain the best results of practical training of the kind mentioned it is of importance that the student should be brought into contact with those who are not merely teachers but also investigators. In the selection of heads of departments the trustees of the university and of the hospital have kept in view that a great medical school should not only teach medicine but also advance the medical science and art. We feel that we may take just pride in the number and value of the published contributions to medical knowledge by members of the staff of the school and hospital and, indeed, it is a sign of great promise that several of our students have already conducted noteworthy investigations, leading in some instances to important discoveries.

In a school with such standards for preliminary training and with such opportunities and methods of study, it is self-evident that the standard of attainment should also be kept high, so that the bestowal of its diploma may be a real distinction to such as attain it. In this respect the faculty have felt a serious sense of responsibility, directed solely by the desire that no one shall be promoted to the doctorate of medicine in this university who does not measure up to the high standards which have here been set.

I have endeavored to point out in a few words the lines along which this medical school in the short period of its existence has developed and certain of its salient characteristics. We feel that we have here an unrivaled opportunity for the development of a great medical school, devoted to higher education and the advancement of medicine. The time is one of marvellous activity and progress in medicine, with new paths and new vistas constantly opening for exploration. We cannot occupy the vast field so fully as we desire. We need ampler resources to take full advantage of our opportunities. I know of no direction in which pecuniary investments for education

with liberally educated classmates, and the resulting tone and morale of the school are elevated, in welcome contrast to the traditional conception of the social and moral atmosphere of a medical school. It is evident that far better methods of teaching and better results can be secured with highly trained students than with those without adequate preparation.

While we designate our required period of medical study as four years, it is in reality from five to six years, for we relegate to the period of preliminary collegiate training the study of general chemistry, physics and biology, which are included in the medical curriculum of many schools, especially in Europe. The study of these sciences, which is justly considered to be an essential part of a thorough medical education, can be pursued to greater advantage in a college or university than in a medical school, and the arrangement which we have adopted adjusts itself readily to the existing conditions in our best colleges and universities.

Coming to us with this exceptional training, our students have a right to expect exceptional advantages for the study of the profession which they have chosen, and, so far as our resources permit, we have endeavored not to disappoint them in this respect. The aim of the school is primarily to train practitioners well grounded in the fundamental medical sciences and in practical medicine and surgery and their branches. We have broken completely with the old idea that reading books and listening to lectures is an adequate training for those who are to assume the responsible duties of practitioners of medicine. Anatomy, physiology, physiological chemistry, pathology, bacteriology, pharmacology and toxicology are taught during the first two years by practical work in the laboratory, and in the last two years disease is studied in the dispensary and at the bedside, not merely as it is described in books.

At the beginning we had only one laboratory building; in 1894 we were provided with a second commodious building, the Women's Fund Memorial building, intended for the various anatomical sciences; in 1896, through a generous gift to the hospital, we were enabled to construct the clinical laboratory, and in the coming autumn a still larger building, now in process of erection, will be ready for the laboratories of physiology, physiological chemistry and pharmacology. We shall then be well equipped with the needed laboratories, which constitute the workshops of our students during the first two years of the course.

From these laboratories the students pass at the beginning of the third year directly to the dispensary and the wards of the hospital, where our arrangements to enable them to become practically familiar with the symptoms, the diagnosis and the treatment of disease constitute perhaps our most original and valuable contribution to the methods of teaching practical

medicine. The generous cooperation of the trustees of The Johns Hopkins Hospital, in accordance with the wishes of its founder, in rendering available for the instruction of students the resources of this great institution, has placed it in our power to make the years devoted to the training in the practical branches of medicine and surgery peculiarly attractive and efficient. They also provide for a large number of our graduates, as well as to others, opportunities to serve as internes in the hospital.

The advantages of thus coming throughout the entire course into direct personal contact with the objects of study are not merely that the students thereby acquire a more useful and living knowledge of them, but that they become familiar with scientific methods and acquire something of the scientific spirit of investigation and of approaching medical problems. They should thus be enabled by their subsequent observations and experience to carry on an education, only begun at the medical school, and which should continue throughout their professional lives.

To obtain the best results of practical training of the kind mentioned it is of importance that the student should be brought into contact with those who are not merely teachers but also investigators. In the selection of heads of departments the trustees of the university and of the hospital have kept in view that a great medical school should not only teach medicine but also advance the medical science and art. We feel that we may take just pride in the number and value of the published contributions to medical knowledge by members of the staff of the school and hospital and, indeed, it is a sign of great promise that several of our students have already conducted noteworthy investigations, leading in some instances to important discoveries.

In a school with such standards for preliminary training and with such opportunities and methods of study, it is self-evident that the standard of attainment should also be kept high, so that the bestowal of its diploma may be a real distinction to such as attain it. In this respect the faculty have felt a serious sense of responsibility, directed solely by the desire that no one shall be promoted to the doctorate of medicine in this university who does not measure up to the high standards which have here been set.

I have endeavored to point out in a few words the lines along which this medical school in the short period of its existence has developed and certain of its salient characteristics. We feel that we have here an unrivaled opportunity for the development of a great medical school, devoted to higher education and the advancement of medicine. The time is one of marvellous activity and progress in medicine, with new paths and new vistas constantly opening for exploration. We cannot occupy the vast field so fully as we desire. We need ampler resources to take full advantage of our opportunities. I know of no direction in which pecuniary investments for education

will yield larger returns in advancement of knowledge and promotion of the welfare of mankind than in the endowment of higher medical education.

Medical departments of universities in this country have usually been such in name only and at best have been looked upon as step-children, out of harmony with true university life and ideals. A medical department which brings to the university only liberally educated men and women, provides a four years' course of study conducted with the best methods, cherishes the scientific spirit and contributes to the advancement of knowledge, is surely a worthy member of a university, however high its ideals. The medical department which has here been founded has been cordially received by this university as equal and coordinate with its philosophical department. This intimate union of medical school and university is of mutual benefit, and in this close association we find constant encouragement and incentive to attain the best. We have been guided throughout by the unceasing care and wise direction of the president of this university, and we believe that the enlightened and generous policy of the trustees of the university and the hospital has brought to fulfillment the wishes of the founder of this university and of the hospital concerning the medical school for which he provided.

Members of the Graduating Class.—In behalf of my colleagues and for myself I congratulate you upon the satisfactory completion of a prolonged period of liberal and professional study in preparation for your chosen career.

You, with the class which preceded you, came to us when you could not see plainly the end from the beginning, trusting in assurances held out to you for the future. You have participated in the establishment of this medical school. This circumstance imparts peculiar interest and intimacy to your relations with us.

It is during this formative period that the impress of students' ideals and conduct upon the inner life of a university is most distinctly felt and that traditions are formed which may powerfully influence the future health and vigor of the institution. That your influence upon this inner life has been for good, we feel assured. During all these four years we have been stimulated by your diligence, enthusiasm, ability and desire for knowledge, and we appreciate your hearty cooperation with our efforts. We, your teachers, have acquired more than a teacher's interest in you. Intimate acquaintance has led to genuine friendship, and we do not doubt that we shall have occasion to feel a personal pride in your future good work. You go forth with the best wishes and high expectations of all of us.

You have acquired some knowledge of the fundamental principles of medical science, some practical familiarity with the nature and treatment

of disease and injury, the ability to use the instruments of your profession, and, above all, I trust, correct methods of work and a trained scientific spirit of investigation. Of the entire contents of the science and art of medicine you have, however, learned relatively only a small part, but you are now in position to increase your knowledge through your own individual efforts and through experience to acquire wisdom.

Such a training as you have received should enable you to derive satisfaction of a high order in the pursuit of your profession, a satisfaction not to be obtained from its practice merely as a trade and means of subsistence. The scientific physician of today finds intellectual pleasures, as never before, in the study of the science and the practice of the art of medicine, and this scientific interest is dignified and enhanced by the power, ever increasing, of doing good to others through the relief of pain and suffering. To the ranks of this noble and useful profession we now welcome you.

Mr. President.—In the name of the medical faculty I have the honor to present to you twenty-two candidates whom we recommend for promotion to the degree of Doctor of Medicine in this university. All, after receiving a liberal education indicated by a degree in arts or science and fulfilling all of our requirements for admission, have spent four years in the study of medicine and have satisfactorily completed the course in this university.

TWENTY-FIFTH ANNIVERSARY OF THE JOHNS HOPKINS HOSPITAL, 1889-1914[1]

I wish to express in behalf of all my colleagues the exceeding joy we have in the return of so many members of the staff of the hospital and of the graduates of our school. Our dearest possession is the work of these men, and the most significant event of this celebration is their return on this occasion.

Much that I might desire to say has already been touched upon. I will add a few words as to what went before the opening of the hospital in 1889, and the situation which existed at that time. We had first of all a generous endowment. In the letter of Johns Hopkins to the trustees, we also had the most memorable sentence already quoted: "You will bear in mind in all your work in relation to the hospital that it is my desire and purpose that this institution shall be a part of the medical school of the university for which I have amply provided in my will."

That is the keynote, it remains the keynote in all that has been done in the hospital and the medical school, and I think we may fairly claim that the wishes of Johns Hopkins in this regard have been fulfilled by his trustees and by those working in the hospital and school. When one stops to consider that these words were penned by a layman in the year 1873 when the medical education was at an extremely low state in this country, and how even today they would be remarkable, it is well for us to pause to pay tribute to the extraordinarily enlightened sentiments of this beneficent donor.

Throughout the construction of the hospital, the conception of Johns Hopkins that it should be a part of the future medical school, was never lost sight of, and all honor to that great man Dr. Billings, who advised the trustees so intelligently in all of these matters. Most significant for the future of the university and medical school was this association with the hospital.

The university, through President Gilman, had already done a work for higher education which constituted the foundation and ideal of the future hospital and medical school. President Gilman was singularly interested in medicine. In planning the work and character of the university, he con-

[1] **Report of an address delivered upon the occasion of the celebration of the Twenty-fifth Anniversary of The Johns Hopkins Hospital, Baltimore, October 5, 1914.**

Johns Hopkins Hosp. Bull., Balt., 1914, XXV, 363-366.

stantly had in mind the needs of the future medical school. The principal address at the opening of the university was by Huxley, and no small part of it related to the problems of medical education. The sciences fundamental to the study of medicine—physics, chemistry and especially biology—were provided for amply and most fortunately by President Gilman by the choice of Rowland, Remsen and Newell Martin. I must pay tribute to the work of Newell Martin who did so large a service to the development of biological science in this country. He created an atmosphere here which has continued to this day to pervade our thoughts and spirits. We owe to him a debt of gratitude hardly to be expressed.

President Gilman had sought the advice of many leaders of medicine in this country and Europe concerning the best plans for the new medical school. One of the first things that I was asked to do when I came in 1885, was to outline what I considered to be the best organization of the medical school. The work of the pathological laboratory began in 1885. It was opened first in the biological laboratory and later in 1886 in one of the hospital buildings which had been completed for the purpose. This was occupied by myself and my associate, Dr. Councilman, who was already here when I came and proved a great inspiration and stimulus to all.

I must pause to consider those first years work in the pathological laboratory, before there was an hospital. The first fellow in pathology was Dr. Franklin P. Mall. At the same time Dr. William S. Halsted was engaged in experimental work. Dr. Christian A. Herter was also a research worker. I would further call to mind that before the medical school was started, there were in the laboratory, Flexner, Abbott, Nuttall, Bolton, Blumer, Walter Reed and others. The list is too long to be given here.

The state of medical education when The Johns Hopkins Medical School was started was most favorable for the development of such a school as we had in mind. As early as 1880 there had been efforts to improve the medical schools of this country. We cannot look back with satisfaction to the state of medical education during the early part of the nineteenth century. By 1880 Harvard Medical School, the school at Ann Arbor and a few other medical schools had already taken steps to improve the standard. There was consequently an eagerness on the part of the medical profession to see the establishment of a school of a higher order than any which existed at that time. We felt that to add one more similar medical school to the list of those already existing would be of little service to the community or to the country, or to the cause of medicine.

At the end of that wonderful decade, 1880-1890, perhaps the most wonderful decade in the history of medicine, there had been a revolution in medical thought through the discovery of the agents causing infectious diseases—

such discoveries as the bacillus of tuberculosis, of Asiatic cholera, of diphtheria, of typhoid fever and other infectious diseases. Those living today can hardly realize the enthusiasm and youthful spirit which was stirred not only among medical men, but in the general public by these discoveries.

It has already been stated that the hospital was opened in 1889, four years before the medical school. Dr. Osler was called in 1888 and Dr. Halsted was already here. Dr. Kelly came soon afterwards. However, there had been the nucleus of a medical faculty from the early years and meetings of the medical faculty in fact were really held before the opening of the hospital. We were disappointed that the hospital should open before the medical school had started, but as I look back, I agree with Dr. Hurd that this was doubtless a distinct advantage. I cannot attempt to elaborate the points suggested, and will only call your attention to the fact that the character of the organization of the staff of the hospital was probably determined by the fact that there was no medical school. That organization remains today one of the most distinctive features of the hospital. You recall that we speak of the resident house staff frequently as our upper staff. It consisted of men selected by scrutinizing the available candidates, wherever found, and appointing them for indefinite periods, many in fact remaining for several years. Dr. Thayer came in 1890, and succeeding in 1891 the first resident physician, Dr. Lafleur, remained on the hospital staff in the same capacity for eight years. The significance of this fact is that we thus afforded opportunities for training in the higher departments of medical work, similar to those afforded in laboratories for training in the sciences. It differs from the system of rotation in vogue elsewhere, and has been one of the great sources of service to the hospital, in that young men of great promise have been attracted here by these unusual opportunities. The list of those who have been resident physicians, surgeons, gynecologists and obstetricians will help you to realize that this has been one of the distinctive features of our organization. Such provision for the higher grades was in large measure due to the fact that the hospital was started before the medical school opened. The hospital was therefore an educational institution.

Dr. Osler has pictured the spirit of those early days, so I shall not attempt to add anything to what he has said. All who are here today from these early years feel that there was an environment, an atmosphere and ideals which will always be cherished and will continue to be an abiding influence.

As I have said, it was a disappointment that we could not start the medical school at the time the hospital was opened, because the trustees felt that the endowment of the university could not assume the additional expense, and that an additional endowment of $500,000 was required for the purpose. This endowment was raised, largely through the efforts of Miss Mary Garrett.

We owe a great deal to Miss Garrett and to the women of the country who contributed to this fund. In Miss Garrett's letter to the trustees there were two conditions: one as to the standards of admission and the other as to coeducation. As regards the standards of admission Dr. Osler expressed the situation when he said to me: "Well, we are lucky to get in as professors, for I am sure that neither you nor I could ever get in as students."

We had no formal opening of the school. We feared to call attention to our institution lest we might have no applicants for admission. However, we opened the school with seventeen students and graduated fifteen of them, most of whom I see here today.

We were somewhat disturbed by Miss Garrett's condition relating to the admission of women. It was a more startling proposition at that time than it would seem today. However, I regard it as a distinct advantage to the medical school that we have women students here, and if we were not bound by the terms of Miss Garrett's gift, we should make no change in that regard.

Let me mention what I consider to be some of the more distinctive features of our hospital and school, some of which I think can be considered as real contributions to hospital organization and medical education. I should place among the first our demonstration of the value of a teaching hospital in association with a university. Patients get far better care in such a hospital. The presence of students in the wards of a hospital is seen to be an advantage in studying disease, in accuracy of diagnosis and in better and more successful treatment of disease. There can be no question that a hospital available to students is the best kind of hospital, from whatever point of view you look at it—whether from the welfare of patients, the advancement of medical knowledge, or contributions to science. One of the most serious problems today in this country is the establishment of such relations as exist here, between hospitals and medical schools which have developed independently of each other. This was never a problem to us.

As Judge Harlan has stated, we have no regulations as to these relations. When inquiries come as to our own regulations and rules in order to fix similar relations between other medical schools and other hospitals, we are somewhat embarrassed. The relations of the trustees of the hospital to the staff and to the faculty are almost ideal. The trustees are ready and eager to listen, and if in their power, to accede to the requests of the medical board.

The fact that the medical school has been an integral part of the university is also important. Here a member of one faculty is on the same footing as a member of any other. The fundamental medical sciences are on a true university basis. All the important fundamental subjects—anatomy, pharmacology, physiology, chemistry and pathology—are in charge of full time men, and have freedom to develop.

The organization of clinical teaching, we owe to a large extent to Dr. Osler. Its most distinctive and useful feature is the admission of students to the dispensary and to the wards of the hospital. Patients are assigned to students, who are thus given opportunities to study disease which previously existed solely for internes. Our whole method of teaching was to a large extent a reaction, which may have seemed almost too sweeping against methods previously existing. There has been little didactic teaching. The whole atmosphere of the place has been that of practical teaching, both in the laboratories and in the wards.

All of this, however, relates merely to organization and to providing opportunities for study. The real results are not there. They are to be sought in the life of the institution, in the men connected with it and those who have gone out of it. It is seen also in the spirit of harmony which prevails, in the concession of the right to each individual to develop, and in the spirit of research. We are here, as one has expressed it, like a family.

I must pause to mention briefly one of the results of the work in medical education, organization and research. If we had not followed such paths, I question if an institution like the Rockefeller Institute for Medical Research could have justified its foundation. If I were to speak of the work of those who have been connected with hospital, many names would suggest themselves, but they are familiar to you all. It is really the work of our graduates which constitutes our most enduring monument. Up to this time, one hundred thirteen graduates of the medical school bear the title of professor and many more are engaged in teaching.

It would be interesting to say something about the growth of the hospital since its foundation, of the new departments due to the generosity of various benefactors—the Pediatric Clinic, the Phipps Clinic, the Urological Institute. I had also intended to touch upon some interesting features of our recent development, namely the limitation of the size of the classes in the medical school, and especially upon the plans for placing certain departments of the hospital upon the university, or so-called full-time basis. I will simply say that the latter came about through an application made to the General Education Board on behalf of the school by the trustees of the university and the hospital, and that we heartily believe that we have splendid opportunity to demonstrate the value of what we conceive to be a great reformation. There is to be provided a staff of professors with assistants in the departments of medicine, surgery and pediatrics to give their entire time to the work of the hospital and the school, not cut off from private practice, but relieved of the difficulties arising from it. Neither Dr. Barker nor Dr. Thayer felt they could accept the position under the new terms, but

we rejoice that they remain with us, cooperating in this scheme, and continuing their services to the school and hospital. We consider ourselves fortunate that we have been able to secure Dr. Janeway as the head of the department of medicine, under this new arrangement. He is enthusiastic and sympathetic, and we are looking forward to the larger opportunity which has been placed in our hands by the liberality of the General Education Board.

I had intended to say a few words about our needs, for we have serious needs, but the hour forbids. This afternoon we have looked back on what we have accomplished. It should turn our minds to the future. In the past we find much to inspire us; we look confidently to continued growth, to the preservation of ideals already established, to the future development of the hospital and medical school and to the training of young men and women for careers of usefulness in the relief of human suffering and in the promotion of general welfare.

SOME OF THE ADVANTAGES OF THE UNION OF MEDICAL SCHOOL AND UNIVERSITY[1]

It is a hopeful and gratifying circumstance that within the last few years universities in this country and in England have shown an awakened and enlightened interest in the advancement of medical science and the promotion of higher medical education. Among the most notable evidences of this interest is the recent organization at the great universities of Oxford and of Cambridge in England of medical departments, not as detached schools, but as integral and coordinate parts of the university. The vivifying influence of this intimate connection between medical study and the university has made itself manifest in zeal for research, equipment of laboratories, improved methods of instruction, and a more orderly and systematic scheme of study.

If I mistake not the significance of the present occasion there are here in Yale University intelligent appreciation of the great purposes to be accomplished by promotion of the best medical education and a desire to render the medical department not less efficient than the other departments of this university.

The present occasion seems an appropriate one to consider some of the relations of medical education to the university.

In this country and in England medicine is taught chiefly in independent professional schools without any connection or with only a nominal connection with a university. An important distinction exists between the independent medical schools of the United States and those of Great Britain, in that our schools have the power of granting degrees, whereas medical degrees and licenses to practise medicine can be obtained in Great Britain only by passing examination at the universities or before the examining boards of certain corporations. The assumption by independent schools of medicine of the power of granting the doctor's degree, without any control from a university or from the state, is a main reason in this country for the lack of uniformity in medical education, for the enormous number of medical schools beyond all necessities of the community, for the ease with which medical degrees can be obtained, and for the consequent degradation in the significance and the value of the degree of doctor of medicine.

[1] An address delivered at Yale University, New Haven, Conn., June 26, 1888. N. Eng. & Yale Rev., New Haven, 1888, XIII, 145-163.

These and other evils of the system of medical education prevailing in this country, are widely appreciated and generally deplored by all who take an enlightened interest in the advancement of the science and art of medicine. They were made the subject of a vigorous address by the president of the American Medical Association at its last session. Probably none recognize more clearly the need of reform than many of the teachers in the best of our medical schools. In general they are to be credited with the desire to accomplish all that is possible in the face of such serious obstacles as the absence of endowments, and the consequent necessity of entering into competition with bad and indifferent schools. The introduction of requirements regarding preliminary education, the lengthening of the period of study, and the establishment of suitable laboratories in several of our medical schools are among the evidences of this desire for reform.

It is not my purpose on this occasion to discuss the serious defects of medical education in this country, or the remedies for their removal. I have called attention to these defects in order to emphasize the widely recognized need for improvement, and the appreciation and support which would be accorded by the medical profession to intelligent efforts to advance the cause of medical education.

While not denying that the essential purposes of medical education can be attained by properly directed independent schools of medicine, I wish to point out some of the peculiar advantages and higher aims which should be associated with a medical department existing in intimate union with the other faculties of a university. To accomplish these purposes and to attain these aims, the medical department should not be dependent for its existence, merely upon the fees of students, but it should receive aid from the state, or better and more in accordance with the prevailing ideas concerning the support of higher education in this country, it should be amply endowed. To this fundamental point I shall return after indicating some of the especial benefits to be expected from such endowment.

Appeal might be made to history to illustrate the beneficial influence of the university upon the development of medicine. We should find in the University of Alexandria the highest development of medicine in antiquity, in Salerno, Civitas Hippocratica, the dawn of mediaeval universities, in Montpellier, Bologna, and Padua, the overthrow of scholasticism in medicine and the revival of scientific investigation, in Leyden the complete adjustment of medicine to the new conditions, brought about by the overthrow of Galenism and by the discoveries in anatomy and physiology, above all by the discovery of the circulation of the blood by Harvey. From Leyden we could trace influences which have affected the organization and the methods of instruction in the leading medical schools of Europe.

But interesting as it might be to follow this historical path, it is more pertinent to my present purpose to direct attention to existing conditions. What does the present state of medical education and science teach as to the best system of medical education?

It will doubtless be admitted by all whose knowledge enables them to form a competent judgment on the subject, that Germany today occupies the leading position in medical education and in medical science. Our own country has produced great physicians whose names are everywhere esteemed. It has contributed an honorable share to the advancement of the art of healing. The production of distinguished physicians, scientific investigation in all branches of medicine, the successful pursuit of the healing art are not the exclusive possession of any race or of any country. While all this is true, it must still be granted that in German universities (including those of Austria, Switzerland, and Russia) we find the most satisfactory and thorough teaching, and the most numerous and important discoveries in medicine. Every year a large number of medical students and physicians from this country visit these universities to find there advantages not to be obtained here.

If we attempted to analyze the causes of German preeminence in medical education, we should find that many causes combine to produce this result, but certainly not the least of these is the fact that medicine in Germany is taught only as a department in a university. Independent medical schools do not exist there. Something more than a feeling of piety for old forms has preserved the historic association of the medical with the other faculties. There is a conviction that the highest interests of medical education and science are best subserved by this association. This conviction is apparent in most of the German literature on medical education, and has been forcibly brought out in the discussions aroused by the proposal to establish in Austria one or more conjoint medical and scientific faculties in order to relieve the monstrous attendance of students in the medical department of the Vienna University.

I have not adduced the status of medical education in Germany in order to make propaganda for the transference to our soil of German university methods. Here, as elsewhere, systems of education must be adapted to the special conditions of the country. There is no reason to suppose that the especial conditions of a German university are essential for the fructifying influence of the university upon medical education. In the University of Cambridge, England, there has developed under Michael Foster a school of physiology, which is clearly traceable to academic influences and which is an honor alike to the university and to English medicine. We should not be justified in supposing that such results cannot be obtained under favor-

able conditions by independent medical schools, but experience demonstrates that the highest development of medical education is attained today as it has been in the past by the university system.

It is doubtless not essential to the conception of a university that it should comprise all of the four traditional faculties. This union, however, belongs to the historic conception of the university and adds to its completeness. We may rejoice that Yale University by conforming to this historic conception, has and will continue to have a larger measure of usefulness and honor. With adequate pecuniary support of the medical department, there is every reason to believe that the association of medical studies with this university will prove no less beneficent for medical education, no less fruitful for medical science than such association has proved in the instances which have been mentioned.

It is hardly necessary to say that these benefits are not the result of a merely formal connection of a medical school with a university. There are examples enough of this purely outward and nominal connection to show that this brings with it no saving power. There must be a union in spirit as well as in name. The influences of university methods and ideals must manifest themselves in the medical department, sympathetic relations must exist with other departments through the connecting link of all, the philosophical faculty, and the cooperation must be obtained of those physical and natural sciences, physics, chemistry, zoology, comparative anatomy, and botany, knowledge of which is essential to a complete medical education and to scientific research in every branch of medicine.

From what has been said, we may conclude that there is great need for improvement in medical education in this country, that there is wide-spread demand for reform, and that experience has shown that the best results are obtainable by a well supported medical school in vital union with a university.

I wish now to point out more specifically some of the advantages which belong to the university system of medical education.

In the first place this system may be expected to maintain the proper balance between purely technical training in the medical art and cultivation of the medical sciences upon which this training sould be based, or to express the same idea perhaps more intelligibly, although in somewhat crude and much abused terms, between the practical and the scientific side of medicine.

It is evident that the study of practical medicine should be preceded by the study of the structure and functions of the human body in health. What the body is and what it does in health must be known before there can be any understanding of what it is and what it does in disease. The normal and peaceful workings of nature must be comprehended before its disordered

manifestations can be understood. Effectual and intelligent measures to prevent and to relieve disease, must be based upon the knowledge of the causes of disease and of the structural and functional disorders produced by disease. Anatomy, physiology, and pathology then must form the foundation of any substantial system of medical education. To any one who is familiar with the present state of these fundamental sciences, it must be clear that they cannot be successfully taught and intelligently studied without thorough knowledge of physics, chemistry, and general biology.

Human anatomy must be pursued in the light of embryology and of comparative anatomy. It then becomes a fascinating study, full of meaning, instead of a mass of unrelated facts to the significance of which there is no clue. Physiology is in large part the application of physics and chemistry to the explanation and the investigation of the bodily functions in health. To the employment of physical and chemical methods, physiology owes its position as the most exact of the medical sciences. "Physiologists," says Du Bois-Reymond, "should regard themselves as chemists and physicists who work only in a particular direction." Pathology, with its two divisions, pathological anatomy and pathological physiology, aims to discover the alterations in structure and in function induced by disease, and it requires no less than do normal anatomy and physiology the assistance of the biological, physical, and chemical sciences.

It is not necessary to elaborate here in detail all of the bearings of these sciences upon medicine. Enough has been said to make plain, that a good system of medical education must include thorough instruction in anatomy, physiology, and pathology grounded upon the natural and physical sciences. while this is generally conceded it is not the less true that these scientific branches of medicine do not receive the attention which they deserve in this country. With few exceptions, the instruction provided in our medical schools in these subjects is very defective, and the opportunities for their practical study meagre.

In a medical school permeated by the university spirit, and in intimate association with a university, these sciences cannot fail to receive proper recognition. It is their presence in the medical curriculum which renders particularly appropriate the incorporation of a medical faculty in a university. They are capable of imparting to the study and the practice of medicine the intellectual enjoyment of scientific investigation. Universities have always kept alive the ideal that the interests of life are not wholly material, but that they are spiritual and intellectual as well. May the time never come when this ideal shall be replaced by the estimate of knowledge, solely for its commercial value, or its immediate application to the practical necessities of life. Somewhat of this true university ideal should per-

vade medical study, if the practice of medicine is to be a profession and not a trade or a handicraft.

In a university medical school of the character indicated, we may look then for the highest cultivation of the medical sciences. These sciences will not be estimated solely by their immediate or apparent practical bearings. With the scientific spirit thus engendered, we may expect to find an elevation of tone and a lofty ideal conducive to a high standard of education and fruitful in the best results for the character, the attainments, and the standing of the medical profession. Such a school in this country would give an impetus to higher medical education and would be an example and an incentive to other medical schools. It is of course not claimed that the results here indicated are possible only in a medical school in a university, but it will not be denied that the atmosphere of a university is particularly favorable for their attainment.

As already intimated the study of the scientific branches of medicine is to be in preparation for the study of practical medicine. The ultimate aim of medical education is, and always should remain, the prevention and the relief of disease. The scientific training has been emphasized, because it is the best preparation for practical medical studies. It is a narrow and short-sighted view which fails to recognize the essential importance in medical education of the study of the medical and related natural sciences. Before this audience there is no necessity of entering into any argument in opposition to such a view.

The development of scientific and of practical medicine during the last half century, has been so immense that the number and the extent of subjects to be mastered by the medical student are far greater than formerly and are constantly increasing. It is a matter for serious consideration, how to distribute these subjects in a medical course, so that each shall receive its proper share of attention. This occasion is not a suitable one to discuss this question, but in view of the emphasis which I have given to the study of the scientific subjects, and that there may be no misconception, I would say that, in my judgment, the last two years of a medical course should be given mainly to the study of the practical branches of medicine. This study I would have more practical and demonstrative than it is with us at present. Systematic lectures on the theory and practice of medicine and of surgery, could be in large part and with advantage replaced by clinical instruction and by recitations from text-books. A little more than two hundred years ago, Sydenham replied to the physician who asked him what medical authors he should study, "Read Don Quixote." Such a reply would not be appropriate at the present day, when the abundance of excellent medical text-books renders no longer necessary mediaeval methods of teaching.

those most terrible scourges of mankind. Who could have foreseen that the little vegetable organisms which were studied over fifty years ago so minutely by Ehrenberg were destined to become so important to the physician and surgeon. Among them today we recognize the specific causes of tuberculosis, of leprosy, of Asiatic cholera, of typhoid fever, of relapsing fever, of malaria, of erysipelas, of traumatic infections, and of a number of other diseases of human beings and of animals. Even the chemical substances by the production of which these microscopic organisms poison the system have in some instances been isolated in a crystalline form. Some time ago a work on lock-jaw was introduced by the legend, *causa obscura, vis notissima est.* Today we can say that there is no disease the cause of which is better understood, for we know not only the living germ which produces traumatic tetanus but also the habitat of this germ and the chemical substance by the production of which its destructive agency is effected.

It would be rash to attempt to forecast the practical importance of these discoveries. Already they have led to such modification and perfection of surgical methods that the infection of wounds from the exterior may be rendered impossible. Antiseptic surgery is a boon to humanity of not less value than the introduction of vaccination and the discovery of anaesthetics.

The discovery of the causative agents of a number of infectious diseases and the possibility of studying the characters of these agents, the conditions favorable and those hostile to their development have proven of great service to public hygiene and have stimulated increased interest in this most important subject. The establishment of hygienic laboratories in the leading universities of Germany is traceable in large measure to the recognition of the importance of bacteriology in the study of epidemic diseases and in other matters pertaining to public health.

The value of a well equipped hygienic laboratory to a community is well illustrated in Munich. In the admirable hygienic institute in that city are studied under Pettenkofer's direction questions relating to sewage, drinking water supply, ventilation, the construction of slaughter houses, and similar subjects. Public spirit has there been stimulated and so intelligently directed that the sanitary arrangements of Munich are now among the best on the continent of Europe and the city has been transformed under adverse natural conditions from among the most unhealthful to one of the most healthful. The professor of pathology there complains that he is no longer able to demonstrate to the student the lesions of typhoid fever.

The study of hygiene has become so specialized that degrees in public health are now given in England and the demand is made that medical health officers shall possess such diplomas as evidence of special training for their duties. I am not aware that in this country opportunities are afforded

for the study of hygiene in a manner at all commensurate with its modern development and importance. We may expect, however, that with increased facilities for higher medical education hygienic laboratories will be established which shall meet the demands of the times.

I have selected the recent discoveries in the causation of infectious diseases as it seems pertinent to my purpose before an audience not composed wholly of medical men to illustrate the progress of medicine. It might be useful to indicate still further the character and the importance of subjects which are now prominent in the different departments of medicine but time bids me return to the more direct elucidation of my theme.

I now wish to call attention to a very practical advantage in making a medical school a department of a university. This advantage relates to economy of organization. A university provides for the study of certain subjects which either are included in a medical course or should be required in a course preliminary to the study of medicine. The most important of these subjects are chemistry, physics, botany, zoology, and comparative anatomy. These subjects are included in the medical course in Germany where they form the major part of the first two years' study in preparation for the *examen physicum.* They are studied, however, in the philosophical and not in the medical faculty.

In the medical schools of this country no provision is generally made for the study of these sciences with the exception of chemistry, and there is probably no more unsatisfactory feature in our medical courses than the teaching of chemistry. As a rule the instruction is chiefly in inorganic and organic chemistry. Physiological chemistry in the modern acceptation of the term is taught scarcely at all, nor can it be to advantage without preliminary training in inorganic and organic chemistry. There is of course just as much propriety, but no more, in including inorganic and organic chemistry in a strictly medical course as in including physics, botany, and comparative anatomy. If a medical school provides for instruction in inorganic and organic chemistry, it should also make provision for these other subjects. This would involve duplicating at great expense institutes already amply provided for at universities, and it is not likely that such institutes in exclusive dependence upon a medical school would flourish.

There is no doubt that the sciences under consideration belong to the general scheme of medical education. If they be included in the curriculum of a medical school as is the case in Germany and imperfectly so in this country, there is the strongest reason that the medical school should be associated with a university where adequate provision is made for their

study. The small measure of success attending the study of inorganic and organic (excluding physiological) chemistry in our medical schools does not encourage us to hope that the establishment of institutes for the study of other physical and natural sciences under similar conditions would yield better results. The school of medicine in Paris is essentially independent of the other faculties of the university and supplies its own professorships of physics, chemistry, and the natural sciences. With reference to this arrangement, Du Bois-Reymond, one of the greatest living physiologists, says, " To the training of the French medical students in the natural sciences by lectures *ad hoc,* although often held by the most excellent men, to their nurture in the atmosphere of a practical professional school in which physics and chemistry are called *sciences accessoires,* I am inclined to attribute the backward position in which, in spite of the appearance of such a man as Claude Bernard, the study of physiology in France, in comparison with Germany, has in general remained."

There have been established within recent years in our colleges and scientific schools, courses of instruction which are intended to be preliminary to the study of medicine, and which are admirably adapted for their purpose. These courses, which, so far as my knowledge extends, are somewhat peculiar to this country, give promise of great usefulness and should receive every encouragement. They are the natural outgrowth on the one hand of the defects in our system of medical education, and on the other hand of the direction in which our colleges have developed.

Here I cannot refrain from expressing the hope that these courses preliminary to the study of medicine may be recognized in the academic as well as in the scientific departments of our colleges. I am well aware that here I am treading upon dangerous ground. In support of this proposition I would present the following considerations.

If a young man choose the medical profession he should devote at least four years to medical studies including the preliminary sciences. One who has had a liberal education will probably supplement this with a year and a half in hospital experience, the value of which cannot be overestimated. He is likely then to devote himself for a year or two to special professional studies, often in a foreign university. If this course of professional study, which is not longer than many pursue, is begun at the age when most young men are now graduated from our leading colleges, then he will not be able to enter upon the active duties of his professional life before thirty years of age or thereabouts. When one considers the long period of waiting and struggle before a successful practice is secured, it will be generally admitted that this is altogether too advanced an age for the beginning of active professional work. I know of instances where this consideration has stood in the way

of young men enjoying the benefits of a college course. This condition of things has also proven a serious obstacle to lengthening the period of professional study, a reform which is imperatively demanded.

Doubtless, as has been recently suggested by President Eliot, improvements should be made in the primary and preparatory schools so that the average age of admission to college may be lowered, without materially diminishing the requirements for admission. If, in addition to this, the last two years of the college course can be devoted mainly to studies bearing directly upon medical education, the evil here depicted would be largely overcome. These studies are not professional. They belong in themselves to a liberal education and are best pursued without reference to their practical bearings. They therefore appropriately find place in the college curriculum. It may be that such a plan as that suggested is contemplated here. It would seem that with possibly some increase in the opportunities for biological studies such a scheme would involve no radical changes in the present course and would be in the line of development of the. college.

To return after this digression to our subject, it may be said that even if chemistry (with the exception of physiological chemistry), physics and the biological sciences before mentioned should be relegated wholly to the so-called preliminary medical courses, it would remain no less desirable that the medical school should be united with the university. The relation of medicine to these sciences is too intimate to suffer divorce from them without detriment. Suitable provision for the study of the preliminary medical sciences in a university is in itself a condition most favorable for the development in the same atmosphere of a medical school. It would often happen that a student finds it necessary to make up some deficiency in one or another of the natural sciences, while pursuing his medical studies, and opportunity for this conjoint study, for which other occasions would also arise, should be present. In the relation, then, of medicine to certain of the natural and physical sciences is to be found one of the most important advantages of the association of a medical school with a university.

Physiological psychology is a subject which should be mentioned as pertaining to medicine as well as to philosophy. Its successful cultivation requires the aid of physiology, anatomy, and psychiatry. Opportunity for the pursuit of this subject should be afforded to those engaged in medical studies. Psychology, however, belongs to the philosophical and not to the medical faculty. This affords another illustration of the mutual benefit resulting from the association of these faculties. We may also expect this association to further the study of the history of medicine, a subject which notwithstanding its interest and value is much neglected. Nothing is more liberalizing and conducive to medical culture than to follow the evolution of medical knowledge.

Finally it may be urged with propriety that a medical department under the administration of a university is a more suitable object for endowment and is more likely to receive bequests of money than are most of our independent medical schools. Those who are acquainted with the organization of these independent schools will not find it difficult to understand why so few endowments in support of medical education in this country have been given.

The first large pecuniary bequest in behalf of medical education in this country was made by Johns Hopkins. This has been recently followed by the Vanderbilt gift to the medical department of Columbia College in New York and by several similar bequests chiefly for the construction of laboratory buildings.

There is no department of higher education which today in this country stands so much in need of pecuniary endowments as that of medicine. The relation of medical education to the public welfare renders especially urgent its claims in this regard. A system of medical education in accordance with modern ideas and adapted to present demands cannot be maintained without endowment or state aid. More is required than didactic and clinical lectures and the simple appliances of former times. There is need of thoroughly equipped laboratories, which, if properly conducted, cannot be made self-supporting. In most of the German universities nearly three times as much money is paid for the support of the laboratories required by the medical faculty as is given in salaries to the medical professors. The medical school must be lifted above the necessity of obtaining its means of existence solely from the fees of students, if a high standard of education is to be attained. At present it would be suicidal for an unendowed medical school to adopt an ideal course of medical instruction. Under present conditions such a school is likely to make its requirements no higher than is demanded by the students themselves.

The manifold benefits which I have attempted in part to depict as resulting from the union of medical school and university cannot be secured to any appreciable degree without endowment.

I cannot conclude this address without saying a few words concerning the advantages which this university presents for the development of medical education along the lines which have been suggested. Here in my judgment are conditions most favorable for the development of a university school of medicine which shall meet modern demands. The only doubt which can arise on this point in the mind of any one is whether there is a sufficient number of patients for clinical instruction. This doubt is not justified by the facts. Of the twenty universities in Germany, all with medical faculties, thirteen are in towns with smaller population than that of New Haven.

In this list are included such famous medical schools as those of Bonn, Göttingen, Greifswald, Heidelberg, Tübingen, Würzburg. This comparison does not lose all force even if allowance be made for the special conditions which favor a relatively larger attendance of patients in the German hospitals. A growing city of 80,000 inhabitants should furnish material adequate for the essential needs of clinical instruction. I am informed by those in a position to know that there is sufficient material here for thorough clinical teaching.

Certainly it is desirable to have as large clinical material as possible, but it is an error to suppose that medical schools can flourish only in connection with large metropolitan hospitals. Even for clinical instruction there are not a few advantages associated with the smaller medical schools. Billroth, one of the most distinguished clinical teachers living, advises medical students to avoid the large and crowded universities, and that too in order to obtain their early clinical instruction. Clinical teaching does not consist simply in the exhibition of a large number of cases of disease. Methods of examination are to be taught. The art of obtaining all of the subjective and objective symptoms, the modes of physical examination, the use of electricity, of the laryngoscope and of the ophthalmoscope, the application of the microscope and of chemical analysis to diagnosis, in a word all that belongs to the propaedeutics of clinical study must be learned. This propaedeutical clinical instruction, which is too much neglected, does not require a large number of patients and cannot be satisfactorily imparted to a large class of students. After this careful clinical training, the larger metropolitan hospitals and clinics can be visited with advantage.

Granted then that the conditions for clinical instruction furnish no obstacle to the development of this medical school, there remain all of the advantages of association with the university.

Here are already established laboratories for all of the natural sciences, the importance of which for the study of medicine has been emphasized. There are already admirable opportunities for the study of physiological chemistry, which, to the best of my knowledge, is nowhere else in this country so adequately represented.

Laboratories for studies and original investigations in anatomy, physiology, pathology, hygiene, and experimental therapeutics are needed. These above all are the medical subjects which can be cultivated nowhere more successfully than under university influences and in cooperation with other natural sciences. The atmosphere of a university town free from the distractions of a large city is most favorable for the scientific pursuit of these fundamental branches of medicine.

To reap the fruit of these advantages the medical department must receive large pecuniary aid. The Yale medical school has an honorable history; but it cannot today attain the height of its endeavor or meet the demands for higher medical education without a considerable endowment.

In no other direction could this university expand with greater promise of usefulness and of renown than in the line of liberal support of the highest and most scientific medical education.

THE ADVANCEMENT OF MEDICAL EDUCATION [1]

Mr. President, Gentlemen of the Harvard Medical School Association.— I esteem it a pleasure and an honor to be invited to participate in this annual dinner. I know something of the zeal and of the high purposes which animate this young association. I see that your constitution places first among its objects the advancement of medical education. Every medical man is supposed to be able and willing at all times and places to ventilate his opinions on medical education, and I suppose it is for this reason that your president has asked me to say something on this subject. It is an old and trite and threadbare subject. We know and are agreed as to the deficiencies in our past and existing systems of education. We are perhaps a little tired of the criticisms and of the truths which have become commonplace, which are drummed into our ears incessantly on this subject. But, until we have more nearly reached the goal, this topic is one which will not down. It is a tale which, like that of the ancient mariner, must be told and retold; and we "cannot choose but hear." You will doubtless live through many disquisitions on various aspects of this question on these occasions, and you are wise to fortify yourselves with a good dinner beforehand.

I notice in the report of your first annual meeting held last year that then, as well as today, the speakers have dwelt upon the value of the close union between Harvard Medical School and Harvard University, and have emphasized the importance of strengthening the bond between the school and the university. I know that this idea is thoroughly appreciated here. It is a matter with which I heartily sympathize and upon which I have had the opportunity of expressing my sentiments in an address before my own Alma Mater. This university idea in medical education means a great deal, and it will, I hope, be kept prominent in your aims. The medical school, according to this idea, is not a mere appendage of the university: it is an integral and coordinate part of it, receiving from it and giving to it reputation and glory.

I know that the objection has been raised that a medical school is essentially a technological school, that its function is to furnish a bread-and-butter curriculum, that it cannot rightfully claim to share the privileges of the humanities or to rank with the liberal studies. If admitted under the shel-

[1] Report of remarks made at the Annual Dinner of the Harvard Medical School Association, June, 1892.

Bull. Harv. M. Sch. Ass., Bost., 1892, 55-64.

ter of the university, it is regarded at best as a child by adoption without legitimate claim to inherit the birthright. You have doubtless heard, as I have, this line of argument amplified.

This position I believe to be wholly indefensible. Dr. Chadwick, in his remarks before you last year and also today, clearly showed that it is contrary to history, and our ideas as to what constitutes a university are largely historical ones. The beginnings of universities in the Middle Ages go back to the school of medicine at Salernum, and from that school up to the present time the medical faculty has been an integral part of most European universities, and of many their chief ornament. Are not today in the University of Berlin such men as Virchow, Du Bois-Reymond, Waldeyer, the peers of their colleagues in the other faculties?

But it is wrong to say that a medical school should be essentially a technological one. Medicine is not only a professional study with practical relations: it is also one of the natural sciences; and it should be the function of the university to see to it that this latter aspect, which is not at all incompatible with the former, is not lost sight of. Many branches of medical study, and those the fundamental ones, are just as legitimate and important and worthy objects of liberal education as any of the natural sciences. They yield to none in fascination or in physiological significance of the truths which they contain and which are to be discovered, and certainly they lose no dignity because these truths bear upon the physical well-being of mankind. It is true, I believe, that such medical sciences as anatomy, physiology, pathology, are most fruitfully cultivated, even in their relations to practical medicine, when they are regarded also as biological sciences, and the practical relations are not kept too exclusively in view. Here it is, as with other applied sciences,—with industrial chemistry, for instance,—that the practical applications of the old and the new truths take care of themselves, and that the best results come from searchers who do not make utilitarianism their guiding principle. There is no direction, perhaps, in which the beneficent influence of university ideas entering into and guiding the work of a medical school is more apparent than in the proper adjustment of the relations between the technical and the more purely scientific aspects of medical study.

The ultimate purpose of a medical school is, of course, the training of practitioners of medicine. It is to teach how best to prevent, cure, and relieve disease and suffering. But I need not combat here in this presence that narrow and Philistine view which seeks a short cut to this goal, and which fails to see that this training is only to be attained on the basis of a thorough knowledge of what the human and animal body is and does in health and in disease,—a knowledge to be satisfactorily acquired only by the

preliminary study of physics, chemistry, and general biology. A medical school which is in close touch with these departments of a well-equipped university, and which is imbued with the university spirit, offers the conditions most favorable for the attainment of these ideals.

Medical education is not completed at the medical school: it is only begun. Hence it is not only the quantity of knowledge which the student takes with him from the school which will help him in his future work: it is also the quality of mind, the disciplined habit of correct reasoning, the methods of work, the way of looking at medical problems, the estimate of the value of evidence. I remember to have heard Cohnheim say that, when called upon to make *post mortem* examinations in private cases for physicians in Breslau where Frerichs had once taught, he could pick out those practitioners who had been under the training of Frerichs by their way of describing and regarding the clinical and pathological features of their cases.

One of the most hopeful signs of the advancement of medical education in this country is the elevation of the standard, not only of those who study, but also of those who teach medicine. A few books and some oratorical gift no longer suffice to make a medical teacher, and the aspirants to professorial honors are no longer expected to begin their apprenticeship with teaching *materia medica* and to climb up gradually the various chairs until perhaps they reach that of medicine or of surgery. It is true that profound learning does not carry with it of necessity the special gifts of the teacher, but I believe that this point of view has been too much emphasized. The well-trained students and the fruitful investigators in their special departments, even if they do not possess the greatest facility of expression, are generally the soundest and most satisfactory teachers.

I believe it would do much to advance medical education and to encourage original research in medicine in this country, if the way were more freely open for academic careers in the sense in which it is in the German universities; that is, if young men who do good scientific work, who publish valuable results of original investigation, and who acquire reputation among those who are competent to judge them, could look forward with some reasonable assurance to securing positions in our leading medical schools. The incentive of this reward acts as a powerful stimulus to original investigation in Germany. And here, again, the influence of the university will be felt,—the university which is not local and provincial, but is national, and, more than national, international and cosmopolitan.

I trust that in this connection I may be permitted to say that Harvard Medical School has recently given a striking illustration of this genuinely national university spirit in the appointments to its professorship of pathology and assistant professorship of physiology. Personally, I cannot regard

your selection for the chair of pathology altogether with composure. You have taken from my right hand my coworker, and you have shorn us of half our strength. We have become so accustomed at The Johns Hopkins University to academic suitors for our young men that our position has been compared to that of the benignant father of a large family of girls in one of your over-populated, feminine towns in this state, who replied to the young man who graciously requested the privilege of marrying one of his daughters: "Take her, young man, take her. God bless you. Do you know who wants another?" Whatever may be thought of free trade in other matters, free trade in the selection of those who are to fill positions of teachers in our universities is conducive to vigorous development.

We have every reason to be hopeful for the future of medical education in this country. The current has set irresistibly in the right direction. We are going to have a few excellent medical schools, unsurpassed by any in any part of the world; and Harvard Medical School will continue to hold a leading position in this advancement. There is going to be a greater disparity than even now exists between those schools most favorably situated, most wisely conducted, best equipped with laboratories and hospital facilities, and amply endowed, and the great mass of schools which cannot secure these advantages in any adequate degree.

We have our own especial problems to solve in medical education in this country. We may, and we should, profit by the experience of other countries; but we cannot transfer bodily their systems of education to our own country, and it is healthful that we should build up our own methods and institutions, and that our schools should be in the line of development from our own special conditions, and adapted to our own institutions and country. You have realized this here to its fullest extent; and I have been very much interested in the efforts which you have made to solve some of these problems, and especially the one which has been touched upon today, particularly by Dr. Pepper, pertaining to the advanced age at which those who complete the academic courses in our leading colleges, such as Harvard and Yale, are obliged to begin the study of medicine. These academic courses have developed, heedless of the necessities of the professional schools. The colleges are going to retain, of course, all this development, and will continue to develop further in the same and in new directions; but the result is that we are placed in an embarrassing and an anomalous condition, without parallel in any other country. Various solutions have been proposed for this anomalous state of things. I do not propose to discuss them here. In fact, I know of no place where the case has been more fully presented and more ably discussed than here; but I wish to express my interest in the efforts which you are making to solve these special problems which pertain to the peculiar conditions of our own country.

We fully realize that at the present day a medical school cannot get along with the simple appliances of former times. Large endowments are necessary for laboratories especially, and here in the Eastern States at least we must look to private philanthropy for this purpose. I think experience teaches that the community at large, even the educated community, takes little interest in matters pertaining to medical education and medical legislation. There is no adequate appreciation of the present state of medical science. The very idea that there is any longer room for special schools and sects and dogmas in medicine, any more than there is in physics and chemistry, is evidence of the ignorance of the general public in this respect. There is room here for a campaign of education. Have the needs of medical education for pecuniary support been as clearly and forcibly presented to the public as might be done? Well-equipped laboratories are essential to medical education; and these, if properly conducted, cannot be made self-supporting. Is it generally known that in the German universities at least three times as much money is spent in the support of the laboratories connected with medical teaching as is spent in the salaries of professors? You cannot, here at Harvard, reach the full height of your endeavor without ample endowment.

Gentlemen, all who have at heart the promotion of the cause of medical education in this country extend their best wishes for the prosperity of the Harvard Medical School and of this association, which can do so much to aid the good cause. For more than two centuries and a half Harvard University has been a model to other similar institutions in this country. May the Harvard Medical School, which has a history of honor and renown in its teachers and alumni and its achievements, continue to be a beacon light in this new era of medical education,—an era in which we may reasonably hope that the days of the lean kine are to be followed by years of plenty?

HIGHER MEDICAL EDUCATION AND THE NEED OF ITS ENDOWMENT[1]

The invitation which I received from the Medical Faculty of the Western Reserve University, to deliver an address upon this occasion, carried with it the suggestion that I should speak of higher medical education, and of some of the advantages of liberal endowment of medical education. My choice of subject is in accordance with this suggestion, as well as with my own inclination.

The time has come when the needs of medical education should be brought forcibly before the general public in this country. Medicine can no longer be taught with the simple appliances of former times. The proper teaching of medicine now requires hospitals, many laboratories with an expensive equipment and a large force of teachers, some of whom must be paid enough to enable them to devote their whole time to teaching and investigating. These things require large endowments of money, and cannot be adequately secured simply from the fees of students. If the public desires good physicians it must help to make them.

In this country, for the most part, we cannot look to the state for endowment of medical education, but we must appeal to private beneficence. A few public-spirited and generous men and women have already given practical proof of their appreciation of these facts. With more general and fuller realization of the needs and present condition of medical education, and of the results that can be secured by its liberal endowment, there is every reason to believe that these benefactions will be largely and rapidly increased, and that thereby the condition of medical education in this country shall cease to be a reproach to us. During the last few years our methods and standards of medical teaching have shown remarkable improvement.

What I shall have to say concerning higher medical education will relate to what may be done where there are adequate pecuniary resources outside of the fees of students, rather than to what may be practicable now in this place or generally in this country. The hampered conditions prevailing in most medical schools in this country do not permit the complete realization

[1] An address delivered at the Graduating Exercises and Fiftieth Anniversary of the Medical Department of the Western Reserve University, Cleveland, Ohio, February 28, 1894.

Med. News, Phila., 1894, LXV, 63-70.

of the methods and standards of education of which I shall speak. One of the principal aims of this address, however, is to indicate the importance of securing endowments, in order to improve the character of medical education. I do not intend, however, to draw an ideal picture, but only one that is realized in many foreign countries, and which is in measurable distance of accomplishment in several medical schools of this country.

What preparation should a student bring to the study of medicine? It is highly desirable, in my judgment, that he should be liberally educated; that is, he should possess a degree in arts or in science which shall be an index of that knowledge and culture which, apart from any immediate bearing upon professional studies, are recognized as entitling their possessor to be ranked among liberally educated men. Scientific studies have acquired the right to rank with classic studies in affording this liberal culture; but the humanities should have a fair share of attention at this period of education.

The question has been discussed whether or not during the period of collegiate education the student who intends to study medicine should be required to pursue any special subjects, and especially such as bear a direct relation to his future professional studies. The answer to this question seems to me to depend upon the character of collegiate training on the one hand, and of medical training on the other hand. The primary purpose of collegiate education is to furnish a broad basis of mental discipline and liberal culture, independently of direct relation to professional work. Where, as in the old-fashioned colleges in this country, and in the gymnasia and lycées of Germany and France, the student enters college at the age of fifteen or sixteen, and is graduated at nineteen or twenty, it is not necessary or even desirable that the undergraduate student should specialize his work with reference to his future profession. Under these circumstances, which obtain in most foreign universities, at least the first year of medical study is devoted mainly to physics, chemistry and zoology, including comparative anatomy.

These are not, however, the conditions which prevail in this country at the present time, where on the one hand the average age of graduation from our best colleges is at least two years later than in Germany and France, and on the other hand, the medical schools do not furnish adequate training in physics, general chemistry, and biology, whereas these sciences are now generally included in the curricula of our colleges. When we consider the fundamental importance of these sciences for the study of medicine, the advanced age of graduation from college, and special conditions of collegiate and medical education in this country, it seems to me clear that during the period of collegiate study the student intending to study

medicine should acquire a fair knowledge of chemistry, physics, and general biology, and to these sciences should be added the study of French and German. Inability to read French and German deprives the physician of personal acquaintance with a large part of the most valuable literature of his profession and makes it impossible for him to keep thoroughly abreast with the progress of medical science and art.

A year's collegiate study, of which practical work in the laboratory should be an important part, is the minimum requirement for such knowledge of physics, chemistry, and biology as should be demanded of medical students upon entrance, and a longer training is desirable. In physics especial attention should be given to mechanical and electrical experiments. The student must learn at least the outlines of inorganic chemistry and the elements of organic chemistry, to enable him to study with any degree of intelligence and profit chemical physiology and pathology. In biology he should follow for at least a year a laboratory course in the structure, life history, and vital activities of selected types of animal and vegetable life. It is more important that he should acquire certain fundamental concepts concerning the structure and properties of living things, than that he should devote his time to systematic zoology. It is impossible to have any adequate understanding of the structure and functions of the human body in health and in disease without a comprehension of the fundamental facts of physics, chemistry, and general biology.

There are certain points which should be clearly understood as regards the requirement that the preliminary education of a medical student should be a liberal one, indicated by a degree in arts or science, and should be made to include a specified amount and kind of knowledge of physics, chemistry, and biology, with a reading knowledge of French and German. The justification for the latter requirement is that, inasmuch as students are kept in college in this country two years longer than in most foreign countries, they should be permitted to pursue during at least the last two years of their course subjects that bear upon the study of medicine, but which, although included in the medical curriculum in foreign universities, are strictly liberal studies, independently of their professional bearings. These sciences preliminary to medical study can be studied and taught better in the college than in the medical school, and, indeed, in foreign universities they are more often pursued by medical students in the philosophical than in the medical faculty. It would be a waste of energy and money to make provision for them in both the medical and the academic departments.

It cannot be truthfully said that the plan indicated need divert the preliminary education from a liberal to a technical and specialized one, for

the degree in arts or science will presumably indicate that the student has a liberal education and the special subjects need not be taken up before the last two years of the course. This scheme presupposes that the student will have made up his mind to study medicine in time to include these special subjects in his undergraduate studies. If he has not done so, or if he chooses to exclude them from his collegiate work, he will be obliged to devote at least a year to them after graduation and before beginning the study of medicine. The college authorities should, however, direct attention, at the proper period of the course to the importance of these subjects for those who intend to study medicine. This plan, moreover, adjusts medical education to existing conditions of collegiate education in this country, without any essential changes in the curriculum of the latter.

The advanced age of graduation from college is a serious embarrassment to higher medical education in this country and has led to the unfortunate result that with the increase in the time required for the study of medicine there has been a falling off in the number of medical students with a college degree in at least one of our leading medical schools, although it cannot be doubted that the average amount of preliminary education has increased among our medical students.

Various suggestions have been made, especially by the medical faculties of our universities, to remedy this anomalous condition of collegiate education or to adapt it to the needs of medical education. I think that we may assume that the college course is not likely to be shortened, or that the college will relinquish that part of its development which has made it something between the old college and a university. There is good reason to believe that there are serious defects in our systems of primary and secondary education, and that without lowering the standard of admission better methods of teaching will enable students to enter college at least a year younger than is now the case.

The plan has been adopted in some of our colleges of permitting students to begin their medical studies in the medical department at the beginning of their senior year. This is a plan which, of course, is applicable only when there is a medical school in connection with the college, and involves certain sufficiently apparent difficulties. I think, however, there is much to be said in favor of this arrangement, which permits the student to take up the study of human anatomy, physiology, and physiological chemistry in his senior year in college, provided he has sufficient preliminary training in the fundamental sciences that have been mentioned. It may, however, be questioned whether the time available for the study of physics, chemistry, and general biology in college is any too long for this purpose, and will permit the addition of human anatomy with dissections, and other subjects

that must be a part of the regular medical curriculum. Unless the student has completed the work of one year of the medical course, I do not see the justification of permitting him to shorten by one year the regular medical course because he has a college degree.

It should be understood that if a medical school requires for admission a year's collegiate training in physics, chemistry, and biology, subjects that are included in the medical curricula of European universities, its period of medical study is, according to European standards, lengthened by one year, the first year being relegated to the collegiate period.

The only medical school in this country in which a liberal degree is required for admission is that of The Johns Hopkins University. Here it is also required, for reasons that have been stated, that the candidate for admission shall be able to read French and German, and shall have had a year's collegiate training with laboratory work in physics, chemistry, and biology. It is of course impossible for unendowed medical schools to demand anything approaching these conditions for admission. I do not undertake to say that, even were other medical schools so situated that they could demand them, it would be wise for them to do so under present conditions, but it seems to me that there is room in this country for at least a few medical schools with such a standard. Exactly what it is feasible to require as a general standard for admission to medical schools in this country at the present time is a subject which, as already said, I do not consider in this address.

It is true that without a liberal education a man may become a competent physician, and may attain even a high standard of excellence in his profession, but with such education he is better adapted for the study of medicine, he is more likely to succeed in his profession, his social position will be better, and his life will be fuller.

The ultimate and essential aim of medical education is to train persons to treat conditions of disease and injury of the living body. This art, the most difficult and responsible of all human arts, rests upon a foundation of scientific facts relating to the structure and functions of the body in health and in disease. These fundamental facts are comprised in anatomy, physiology, and pathology. Upon the basis of these medical sciences the student is prepared to study the nature of therapeutic agents and their effects upon the body, and to proceed to the study of practical medicine and surgery. The greater part of the time to be devoted to the practical branches must be given to general medicine and surgery, including obstetrics and gynecology, but opportunities must be afforded for acquiring some knowledge of the various specialties. Instruction should be given also in hygiene, legal medicine, and medical history.

To anyone who is at all familiar with the contents, constantly increasing, of these various branches of medical study, it is clear that it is hopeless to attempt to give the medical student a complete knowledge of any one of them. This would require for each subject a period of time at least equal to that available for the study of all.

How long should be the period of undergraduate study in a medical school? In Europe it is nowhere less than four years, and in most European countries it is longer. In Sweden it is nine or ten years, in Spain seven years, in Italy and Holland six years, in Austria, Russia, Portugal, and several universities of Great Britain five years, in Germany four and a half years. In Canada the required period is four years.

According to a statement kindly furnished to me by Dr. John S. Billings, fourteen regular medical schools in the United States either now require, or during the coming year will require, attendance upon four annual courses of lectures in conferring the degree of doctor of medicine. Thirty-seven schools require four years of study, of which one year may be only with a preceptor. Seventy-six require three courses of lectures, and seven require only two courses.

The required period of study in the Medical Department of The Johns Hopkins University, where a full year of collegiate training, with laboratory work in physics, chemistry, and biology, is required for admission, is, according to European standards, at least five years.

Four years of undergraduate study in a medical school each year of study being the usual academic year of about eight months, are as much as can reasonably be demanded in this country at the present time. This length of time is sufficient, if the student enters with a satisfactory preliminary training, especially if, as is often the case, he supplements the undergraduate course with a year or a year and a half in a hospital, or a year of special post-graduate study.

Only those medical schools that have good laboratory and hospital facilities are warranted in establishing a four years' obligatory course. It would be absurd for some medical schools, with their pathetically meager outfit, to require the student to remain with them four years.

As regards the distribution of subjects in the medical curriculum, the amount of time to be given to each, and the methods of teaching, there is, of course, room for much difference of opinion. I should say that in a four years' course the first two years should be devoted mainly to the fundamental medical sciences, to wit: anatomy, physiology, physiological chemistry, pathology, including bacteriology, and pharmacology, and that the last two years should be given to practical medicine, surgery, obstetrics, and hygiene, with limited consideration of the more important specialties. Before enter-

ing upon the latter half of the course the student should pass an examination upon the studies of the first two years. The examinations upon both the scientific and the more strictly professional subjects should include practical exercises.

The study of human anatomy will extend through the first two years, and will include in the first year dissections and laboratory courses in normal histology and embryology. Gross anatomy should be taught mainly by dissections and from text-books. Applied anatomy and special dissections will fall mainly in the second year, and partly may be left, as regards special points, to the supervision of the teachers of the practical subjects.

My preference is for the Continental rather than the English conception of the department of anatomy, viz., that the professor of anatomy should be a scientific man, broadly trained in comparative and human anatomy, not engaged in professional practice, and having under his supervision all that belongs to the normal anatomy. He should be well enough paid to be able to give his whole time to his subject, and should have under his charge a well equipped anatomical laboratory. There is, however, no serious objection to referring the instruction in normal histology and embryology to the physiological department. Indeed, it is desirable that some consideration of physiological function should be combined with the instruction in microscopical anatomy.

The subject of physiology, which treats of the normal functions and activities of the body, is of the first importance in medical education. It has attained a higher degree of precision in experimental methods than any other medical science. A good knowledge of physiology is the best corrective to irrational theories and practice in medicine. Physiology has become a highly specialized science, and should be represented in the medical school by a good physiological laboratory and a teacher who is thoroughly trained in physiological methods, and can devote his whole time to the subject. It should be taught by demonstrative lectures, text-books, and laboratory courses. Laboratory courses in physiology, although important, are hard to arrange, on account of special difficulties inherent in the subject. They do not, therefore, play so predominant a rôle as in the teaching of anatomy and pathology. The study of physiology will continue throughout the first year, and may extend into the second.

The chemical side of physiology has become so large and specialized and is so important in medical education that chemical physiology, or as it is generally called, physiological chemistry, has come to be recognized as a distinct department in many medical schools. There are advantages in keeping this branch of study in the physiological laboratory. Whether or not it is made subordinate to physiology or is established as a separate department

will depend largely upon the special interests of the professor of physiology and the kind of man selected to teach physiological chemistry, as is illustrated by the different arrangements in this regard in the German universities. The teacher should be a thoroughly trained chemist and also familiar with physiology and medicine.

Physiological chemistry means much more than what is usually taught in our medical schools as medical chemistry, which includes little more than the chemical analysis of certain fluids of the body for diagnostic purposes. Anatomic structure and physiological function depend to a very large extent upon chemical composition. Our knowledge of the processes of nutrition, digestion, and secretion, both in health and in disease, has been greatly advanced in recent years by the work of physiological chemists. The micro-organisms that cause infectious diseases do injury largely by their chemical products, and many of the questions relating to infection and immunity can be answered only by the aid of chemical investigation.

"I cannot understand," says Hoppe-Seyler, as quoted by Chittenden, "how at the present day a physician can recognize, follow in their course, and suitably treat diseases of the stomach and alimentary tract, of the blood, liver, kidneys, and urinary passages, and the different forms of poisoning, how he can suitably regulate the diet in these and constitutional diseases, without knowledge of the methods of physiological chemistry and of its decisions on questions offering themselves for solution and without practical training in their application."

Physiological chemistry in the broad sense that I have attempted to indicate should receive proper consideration in a medical school. Its physiological and pathological bearings should be emphasized. It should be taught during the first year largely by laboratory courses. It is important, as already stated, that the student should enter with sufficient preparation in inorganic and general organic chemistry to enable him to proceed at once to the study of chemistry in its physiological relations.

Pathology I would place as a principal subject in the second year. This subject embraces general pathology, gross pathology anatomy, and pathological histology, and with it can be appropriately associated bacteriology. The student should be taught the proper methods of making post mortem examinations and of recording the results in protocols. The teaching should be by lectures, text-books, and to a very large extent by demonstrations and laboratory work. As abundant use as possible should be made of the demonstration of fresh pathological specimens, which at the same time can be studied in fresh microscopical sections. Bacteriology can be taught in a laboratory course of two or three months.

It seems to me advantageous that the systematic study of pathology should precede that of the clinical subjects. The latter, however, should be accompanied with the demonstration of pathological specimens and with courses in clinical microscopy, so that the pathological knowledge and experience of the student will be kept fresh and will be increased during the last two years of the course. The pathological laboratory, which it is desirable to have in close connection with the autopsy room, should be in charge of a professor who gives his whole time to the subject, and it should be well equipped for work in all departments of pathology, including bacteriology. An active and well organized pathological laboratory can have a very important influence for good upon the life and scientific activities of a medical school and hospital.

Pharmacology, or the study of the nature of therapeutic agents and their behavior and effects in the living body, has become of late years a more scientific subject by closer association with the methods of physiology, chemistry, and experimental pathology in investigating the action of therapeutic agents upon patients and experimentally upon animals. Our knowledge has become greater and more precise as to the behavior of drugs within the body, and as to their action upon the circulation, digestion, secretion, and other processes and functions of the body. A large number of new drugs are constantly brought to the attention of the profession. Of these Dr. Delafield has said: "Many of the new drugs are of much help to us; we can do useful things today that we could not do some years ago, but it must be admitted that we can also do harm in a greater variety of ways." There is a tendency to greater simplicity in prescriptions and a more extensive employment of other than pharmaceutic methods of treatment.

The teacher of pharmacology should be trained in the modern methods of pharmacological research, and he should have under his charge a laboratory in which the student may acquire by practical work some of this knowledge.

The teaching of the application of therapeutic agents to the treatment of disease should fall to a large extent upon the teachers of clinical subjects.

As the time of the student will be so fully occupied with anatomy, physiology and physiological chemistry, and the corresponding laboratory-work during the first year, the study of pharmacology may be left to the second year, where it seems appropriately to belong.

When we are told that hygiene is the study of the causes and prevention of disease, and that its aim is to preserve and to promote health, it would seem as if this subject were of the first importance in medical education. But when we consider what a complete department of hygiene really means, and what are the problems with which the modern hygienist has to deal, such questions as the sanitary condition of houses and communities, the

contamination and purification of drinking-water, the disposal of sewage, the adulteration of food, the dangers of certain occupations, the study of vital statistics, matters relating to sanitary legislation, it is apparent that undergraduate instruction in hygiene for the medical student must be more restricted than the theoretic and practical importance of the subject would seem to indicate. Still it is important that some instruction in this subject in the form of demonstrative lectures should be an obligatory part of the course, and among the optional subjects of the last years of the course, laboratory work in hygiene may be well included. Many licensing and examining medical boards require that the candidate shall be examined in hygiene. The student should learn at least enough of sanitation to know that there are many sanitary subjects upon which intuitional judgments are of no importance, and that as regards these only the opinion of a sanitary expert is of any value.

Practical training in bacteriology falls in many foreign universities to the department of hygiene. This must be taught, but it makes little difference whether it be taught in the pathological or in the hygienic laboratory, although personally I prefer its association with pathology. Each of these laboratories must be supplied with facilities for bacteriological work.

We owe to Pettenkofer, of Munich, the first organization of a complete hygienic laboratory, and this has served as the model for many others. The Munich laboratory has been one of the ornaments of the University, and has been of inestimable value to the city in bringing about such great improvements in public sanitation that typhoid fever, the most significant index of the hygienic condition of a city, has virtually disappeared, whereas it was formerly so prevalent that visitors were warned against it. The development of bacteriology and its association with hygiene has led during the last decade to the establishment of a department of hygiene in most German universities. Fortunate that medical school, and especially fortunate that city, in which there is a well equipped and active laboratory of hygiene. So beneficent may be the working of such a laboratory to the general community, that this is a department for which the support of the public could be reasonably solicited. Medical officers of public health should of course be especially trained in hygiene, as is required in England.

The last two years of the medical course should be devoted to the study of the strictly professional, the so-called practical, subjects. The previous study of anatomy, physiology, physiological chemistry, pathology, and pharmacology has been the best preparation for the pursuit of the practical branches of medicine, and it should be recognized that the place of these sciences in the course and the amount of time devoted to them are justified on the ground that they furnish an important part of the training of practitioners of medicine and surgery.

The teaching of the strictly professional subjects must be eminently practical and cannot be satisfactory without sufficient clinical material. The student should have the opportunity of frequently observing patients in the hospital wards, in the operating room, and in the dispensary, and of seeing methods of treatment and their results. He should come into personal contact with patients, should examine and study them, should take their histories, follow the course of disease, and report upon the cases. Attendance upon clinical lectures cannot take the place of this direct, personal, continuous observation of cases of disease. Students during their last years should enjoy some of those advantages of a hospital service that have usually in this country been reserved for the fortunate internes. It is especially as regards arrangements for such personal clinical work for the students that our overcrowded medical schools are at a disadvantage as compared with schools of smaller attendance. Hence Billroth, in each of the fifteen editions of his "Lectures on General Surgical Pathology and Therapeutics," has admonished students: "Flee therefore in the beginning of your clinical studies the great universities."

The attempt to cover the whole ground of the theory and practice of medicine and of surgery in courses of didactic lectures is rapidly giving place to systematic clinical teaching and recitations from text-books. Practical courses in methods of diagnosis and in the use of clinical instruments of precision are essential. Clinical laboratories have become a valuable adjunct to the department of medicine, and should afford to the student practical courses of instruction relating to such subjects as the examination of sputum, blood, gastric contents, secretions, etc.

Surgical practice has profited even more than medical practice by the scientific discoveries of recent years. The general principles of surgical procedure have become much more simple and straightforward than formerly, and the results of their application are in the highest degree satisfactory. In the allotted time the student can acquire a fair knowledge of these principles by lectures, clinics, and practical courses, but only study and practice after graduation can make him a surgeon.

It seems to me that a considerable part of the instruction on certain subjects in general pathology—as, for example, inflammation and tumors—often assumed by the professor of surgery, should be left to the professor of pathology. I venture to say also that, according to a distinction in titles, and at least to some extent in usage, in many American medical schools the implication that the main professorship of surgery is one primarily of didactic teaching and the subordinate professorships are those of clinical teaching is singularly unfortunate.

Greater use than is customary can be made of experiments upon animals in teaching some matters pertaining to surgery, such as certain details in surgical technique, the healing of wounds of different parts of the body, their behavior under the influence of antiseptics, of foreign bodies, and other circumstances, etc.

I shall not speak on this occasion of the instruction in obstetrics.

It is impossible for the medical student in his undergraduate days to acquire any thorough knowledge of the various specialties in medicine. Too much should not be attempted in this direction. The study of some specialties should be obligatory, that of others may be optional, but the medical school should furnish opportunities for the study of all.

I should like to see in every medical school a course of lectures upon the history of medicine. It adds to the liberal culture of a physician to learn who have been the great discoverers and the master minds in medicine, what has been the condition of medicine at different periods of the world's history and among different peoples, what doctrines have prevailed, and by what means progress has been achieved.

As regards the methods of teaching medicine, the keynote at the present time is object-teaching. For nearly two centuries traditions derived from the University of Leyden have largely controlled systems of medical instruction. Purely didactic lectures, designed to cover the whole ground of medicine and surgery, acquired undue prominence in the scheme of instruction. We now believe that greater emphasis should be laid upon the study of text-books, and that the student should be brought into direct, personal contact with the objects of study. The scientific subjects must be taught largely by laboratory practice and the practical subjects in the clinic.

While laboratory teaching is of the highest importance, it nevertheless seems to me impossible to give to it too exclusive prominence, although I am reluctant to say this in view of the prevalent defects in opportunities for laboratory work in most of our medical schools. There is no medical school in this country which is able at present to furnish all of the laboratory instruction which is to be desired.

It should be borne in mind that laboratory methods are extremely time-taking and are not adapted to teach the whole contents of any of the medical sciences. It is, of course, hopeless to attempt to demonstrate practically all of even the more important facts that the student should learn. Laboratory work is especially valuable in training methods of thought and observation and in developing the scientific spirit. The knowledge derived from actually seeing, touching, experimenting, is of course more real and impressive than that which comes simply from reading and from listening to lectures, but the student whose knowledge of a subject is derived exclusively

from laboratory courses is likely to lose his perspective in details, to acquire only fragmentary knowledge of a subject, to fail to comprehend the general bearing of observed facts, and not to acquire the general principles and systematic conceptions which are essential. Laboratory courses may be conducted so that some of these defects are minimized and these points would perhaps not need emphasis if the time available for the study of the different subjects were unlimited, but a large number of subjects must be taught in a comparatively short time. Laboratory work should be accompanied and supplemented by the reading of text-books and by lectures. The details of every subject must be learned to a large extent from books. Didactic lectures have their place in presenting the broad outlines of a subject in a systematic way and in emphasizing, as only the living voice can, essential and salient points. Such lectures can be made also demonstrative by drawings, charts, specimens, experiments, the use of the magic lantern and the exhibition of original monographs and works not readily accessible to students.

Recitations upon the subject-matter of lectures, of text-books and of laboratory courses are especially important. They bring the teacher into personal contact with the student, they secure systematic reading and study, they bring to light the difficulties and misconceptions of the student, and afford opportunity for their correction.

As I have already said, only a relatively small part of medical science and art can be taught during a period of four years. This necessitates a careful selection of the subjects to be taught, of the amount of time to be given to each subject, of the sequence in which the subjects are to be taken up, and of the methods of teaching. There must be a careful adjustment of the various parts in their relation to the whole, and in their relation to the ultimate objects of medical education—the training of practitioners of medicine and surgery. No subject should be taught as if the student were to become a specialist in it. The teaching must be simple and clear. The problems that are of most interest to the teacher are often not those with which the student need concern himself. The majority of students will not have opportunity or inclination after graduation to devote much time to a continuation of the study of anatomy, physiology, and pathology, and these subjects, being of fundamental importance, should therefore be taught with much thoroughness.

It is important that the student should carry away from the medical school a certain mass of positive knowledge. It is still more important that he should acquire some measure of medical wisdom and of the scientific spirit, and that he should have that methodic training in observing and in drawing logical conclusions, and that familiarity with instruments

and methods of examination which will enable him to continue independently his education, to follow and incorporate the new discoveries in medicine, and critically to judge and to make the most of his own observations. Medical education is not completed at the medical school; it is there only begun. Of the various subjects in a medical course, the fundamental medical sciences are especially those which afford to the student this methodic training, and are calculated to develop habits of accurate observation and to stimulate scientific interest in the practical side of his profession. The medical art is becoming more and more the application to practice of medical science. It is the development of medicine along the lines of a biologic science that renders it increasingly attractive to liberally educated men with inclinations to scientific pursuits.

The medical school should afford encouragement to special and advanced work. The few who have the capacity, the inclination, and the time to become investigators and teachers should find there stimulus and opportunity. It should be a place where medicine is not only taught but also studied. It should have a share in the advancement of medical science and art by encouraging original work, and by selecting as its teachers those who have the capacity and the training for such work. The heads of departments should be supplied with a sufficient number of assistants, so that their time need not be given wholly to teaching. These assistants ought to be paid. In most laboratory courses there should be at least one demonstrator for every fifteen students. In the selection of assistants preference should be given to young men who desire to carry on original work, who have aptitude for such work and for teaching, and who would like to follow an academic career.

The sketch that I have drawn of a medical school is not intended to be an ideal or impracticable one. It is simply what is realized in many foreign universities and what the best opinion in this country desires. It is not today realized in any medical school in this country, although a few are approaching this standard.

That a medical school as completely equipped as I have indicated does not exist in this country is not due to any lack of appreciation on the part of medical teachers of its necessity, but is due to the fact that such a school cannot exist without large endowment, either from private philanthropy or from the state, and none of our schools has sufficient endowment for this purpose.

A properly equipped and organized medical school, with all of the necessary laboratories and a sufficient number of the right kind of teachers, is an enormously expensive affair, far more expensive than any other professional school. The most pressing need of our medical schools today is thoroughly

equipped laboratories in charge of well trained teachers and investigators who can give their whole time to their special work. The salary of such a teacher as head of a department ought to be not less than from four to five thousand dollars per annum. There should be six of these laboratories, to wit, of anatomy, physiology, physiological chemistry, pathology, pharmacology, and hygiene. It is better to place bacteriology with pathology or hygiene than to make of it a separate department.

The suitable construction and equipment of these six laboratories will cost at a moderate estimate from two hundred and fifty to three hundred thousand dollars. From eight to ten thousand dollars is a moderate estimate of the amount needed to cover the average yearly cost of each of these laboratories for salaries of professors, assistants, janitors, and for current expenditures. I should say that, including the fees of students, the interest of not less than $1,200,000, at 5 per cent, would be required to support a completely equipped medical school in this country. This sum does not, of course, include the amount needed for the support of hospitals connected with the school.

I have been kindly supplied by a friend connected with the Prussian Government with a statement of the amount of money bestowed yearly by the government upon each of the medical institutes in the different Prussian universities. This amount does not include the salaries of the professors in charge of the institutes, but only the salaries of assistants and servants and the sum available for current expenses. I am permitted to publish only the total amounts and not the salaries of individuals.

The annual dotation by the government for each of the following medical institutes in the University of Berlin for the purposes specified is: For the first anatomical institute, 40,690 marks; for the second anatomical institute, 11,430 marks; for the physiological institute, 47,746 marks; for the pathological institute, 24,450 marks; for the pharmacological institute 17,202 marks; for the hygienic institute, 18,500 marks; for the first chemical institute, 26,440 marks; for the second chemical institute, 18,435 marks. The Prussian Government, therefore, expends annually, outside of the salaries of professors, a little over fifty thousand dollars to support the laboratories of anatomy, physiology, pathology, pharmacology, hygiene, and chemistry in a single university. About three times as much money is given by the government to the support of the laboratories as is devoted to the salaries of the professors, but these salaries are largely, often many times, increased by the fees of students. In Germany the expenses of living and of the purchase of laboratory supplies are less than in this country.

Medical education in this country has until recently been left to its own devices. Only within recent years has it received any aid worth speaking

of from private philanthropy or the state, save the indirect aid from the establishment of hospitals and dispensaries.

The greatest impulse for the endowment of higher education in this country has been religious zeal. Contrast for a moment the endowment of theologic study with that of medical study. According to the forthcoming "Report of the Bureau of Education," for proof-sheets of which I am indebted to the kindness of Mr. Harris, the Commissioner of Education, there was in the United States in 1890-91 only five endowed chairs in medical colleges, and not a single one of these south or west of Philadelphia. It may, I think be questioned whether all or even any of the five chairs were adequately endowed. On the other hand, there were 171 endowed chairs of theology, many of these being in the West and South. According to the report of the same bureau, as quoted by Dr. Bayard Holmes, the productive funds in the hands of medical schools, both those connected with and those independent of universities, in the United States was, in 1889, $249,200; while, at the same time, there were in the hands of schools of theology productive funds to the amount of $11,939,631. In 1892, these figures were, for medical schools, $611,214, and for theologic schools, $17,599,979. In 1890-91, out of a total of $1,466,399 given to the institutions for professional instruction, 63 per cent was given to theological schools and 17 per cent to medical schools. Medical departments of state universities received, in 1892, state aid amounting to $40,500; technological schools received state aid to the amount of $747,504. When one considers that there are more than twice as many students of medicine as of theology, and that medical instruction is much more expensive than that of theology, and requires costly laboratories, the contrasts afforded by these figures are startling.

How could this be theological?

The report of the Commissioner of Education comments as follows upon these statistics and similar ones relating to legal education:

"There can be no doubt of the propriety of private philanthropy endowing theological study, nor of the state's enterprise in supporting technical and pedagogical studies, but it is difficult to discover why such consummately practical and important topics as law and medicine should be neglected by private benevolence or public caution. It seems to be conceded that unendowed instruction in law or medicine will be just as poorly given as unendowed instruction in theology or pedagogy. Yet we find instructors in both these sciences, though necessarily state-supported on the Continent of Europe, in America left to live upon the meager diet of tuition-fees."

Higher medical education, no more than any other form of higher education, is self-supporting. A number of reasons might be specified to explain this singular neglect of medical education as an object of private endowment or state aid. I shall not consider these reasons here. Many of them pertain to conditions that have changed or are changing. The tide has already

turned, and "the old order changeth, yielding place to new." The doom of the medical college responsible to nobody, without hospital or laboratory facilities, has sounded.

"Unto every one that hath shall be given, and from him that hath not shall be taken away even that which he hath."

The needs of medical education have begun to be recognized by high-minded and public-spirited philanthropists, such as Johns Hopkins, Vanderbilt, Mary Garrett, and your own John L. Woods. Such benefactors have "linked their names to those imperishable things" which make the most enduring monuments of a republic. I was particularly impressed by Mr. Adams' statement in his memorial address upon John L. Woods in this place, last October, that Mr. Woods' generous benefaction to this college was chiefly determined by "the fact that medical education had never been a favorite object of benevolence, while the improvement of medical education was really of the greatest importance."

In conclusion, let us not forget that a university or a medical college may have large endowments, palatial buildings, modern laboratories, and still the breath of life not be in it. The vitalizing principle is in the men—both teachers and students—who work within its walls. Without this element of life, this bond between teacher and taught, these things are but outward pomp and show. But let these greater opportunities receive the breath of life from the inspiration of great teachers and they then become the mighty instruments of higher education and scientific progress.

THE MATERIAL NEEDS OF MEDICAL EDUCATION[1]

The opening of this new college building, in which provision is made for the teaching of medicine by modern methods, and especially for laboratory instruction, seems to me a fitting occasion to say something concerning the condition of medicine today, and particularly the material needs of medical education. In a country where appeal must be made to private beneficence for the support of higher professional education, it is important that the general public should be informed concerning the requirements for the best training of medical students at the present day.

The century now drawing to a close has witnessed a development in medical science and practice far surpassing that of all the centuries which have gone before. Of the half dozen great discoveries which in their day have revolutionized the science and art of medicine, only that of the circulation of the blood belongs to a past century, while surgical anaesthesia, cellular pathology, the demonstration of the germ doctrine of infectious diseases, antiseptic surgery, and the prophylactic and therapeutic applications of the principles underlying artificial immunity have all been introduced during the nineteenth century. As regards the last, a partial but important exception must be made in order to include the introduction near the close of the last century of vaccination against smallpox. Around these great discoveries, and for the most part dependent upon them, cluster a host of others, and all have combined to change the whole face of medicine. In all directions the stock of medical knowledge has been vastly increased, so that no man can grasp it all, and only a relatively small part can be taught to the student of medicine. Specialization with all its advantages and its defects has become a necessity both on the scientific and the practical sides of medicine. Each of the fundamental medical sciences is now cultivated both for its own sake as well as in its relations to other branches of medical knowledge. We know a great deal more than our predecessors of the structure and workings of a body in health and in disease. Our insight into the causes of disease, particularly of infectious diseases, has been deepened, and hand in hand with this increase of knowledge, although not in direct ratio to the scientific advance, has expanded the power of the physician and surgeon to prevent and cure disease. The ability to prevent the accidental infection

[1] An address delivered at the Opening of the New Building of the College of Physicians and Surgeons, Baltimore, December 21, 1899.

J. Alumni Ass. Coll. Phys. & Surg., Balt., 1900, II, 97-106.

of wounds has greatly advanced the surgeon's art and made it one of the most rewarding and beneficent of human pursuits. Not less striking is the increase in our power to check the introduction and spread of many infectious diseases. Civilized countries with proper systems of public sanitation need have little fear of the pestilences of former times. With the diminution in mortality from the diseases of early life, the incidence of disease is changing toward a preponderance in the diseases of old age. While on that side of the physician's activity with which the public is most familiar, the daily routine of general practice, the progress may seem less apparent, still here also there has been great improvement in methods of diagnosis and in the means of treating disease, even if we must admit that the untrained physician can now do harm in a greater variety of ways than formerly.

But it is only in contrast with past knowledge that the progress seems so great. If we consider what remains to be accomplished, and what we may reasonably hope will be attained, we may well believe that the veil has been lifted only in relatively small part from the mysteries of disease and its prevention and cure. We cannot doubt that we shall advance further along paths already opened, as, for example, in the direction of the specific antitoxic and antiparasitic treatment of infectious diseases, and that vistas of knowledge and power now undreamed of will be disclosed.

The great advances of the present century are due not to any improvement in the mental powers of man, but to the general recognition of the truth that the only way to learn the facts of nature is by observation and experiment. This scientific method of investigation seems to us so obviously the correct and fruitful one that we can only marvel that it was not equally apparent to our predecessors in past centuries. Of course from the most ancient times there have been those who have contributed to natural knowledge facts based upon observation, experiment and just inference, and we are the heirs of great scientific truths which have thus come down to us from past ages. But nothing is clearer to the student of the history of medicine and of science than the prevalence of the opinion, until comparatively recent times, that the secrets of nature could be learned by contemplation and reasoning. This erroneous belief, combined with reliance upon the authority of tradition or of some great name, was the great obstacle to progress and the source of many speculative systems which are so difficult for us at the present day to comprehend, even if we think it worth while to make the attempt.

I cannot better illustrate the value formerly attached to mere reasoning as a basis of scientific discovery than to quote from one of the Essays of Jean Rey, Doctor of Medicine, entitled "On an enquiry into the causes wherefore tin and lead increase in weight on calcination," first published in

1630. These essays are of such interest and importance in the history of science that they have been recently republished by the Alembic Club. Rey to some extent anticipated the results of Lavoisier a century and a half later. His work is a curious combination of well chosen experiments and of metaphysical speculations. The quotation to which I call your attention is as follows:

"My chief care hitherto has been to impress on the minds of all the persuasion that air is heavy, inasmuch as from it I propose to derive the increase in weight of tin and lead when they are calcined. But before showing how that came to pass, I must make the observation—that the weight of a thing may be examined in two ways, viz., by the aid of reason, or with the balance. It is reason which has led me to discover weight in all elements, and it is reason which now leads me to give a flat denial to that erroneous maxim which has been current since the birth of Philosophy—that the elements mutually undergoing change, one into the other, lose or gain weight, according as in changing they become rarefied or condensed. With the arms of reason I boldly enter the lists to combat this error, and to sustain that weight is so closely united to the primary matter of the elements that they can never be deprived of it. . . . . But not presuming that my statements are on a parity with those of Pythagoras, so that it suffices to have advanced them, I support them with a demonstration which, as I conceive, all men of sense will accept. Let there be taken a portion of earth which shall have in it the smallest possible weight, beyond which no weight can subsist; let this earth be converted into water by the means known and practised by nature; it is evident that this water will have weight, since all water must have it, and this weight will either be greater than that of the earth, or less than it, or else equal to it. My opponents will not say that it is greater, for they profess the contrary, and I also am of their opinion; smaller it cannot be, since we took the smallest weight that can exist; there remains then only the case that the two are equal, which I undertook to prove."

This somewhat lengthy citation, upon which no especial comment is necessary, will suffice as an example of the study of nature by unaided reason and dialectics, and the interest attaching to it enhanced by the circumstance that Rey himself made ingenious experiments in natural philosophy, and that he belonged to the century of Galileo, Kepler, Newton and Harvey, a century which has often been compared with our own in respect of interest in scientific discovery.

Rey, in the foregoing quotation, incidentally furnishes an illustration of another characteristic of past systems of doctrine in science and medicine. You may have noticed that he implies that, if he possessed the authority of Pythagoras, his statements would be accepted without demonstration. This blind reliance upon authority is exemplified by the saying of one of the great Arabian physicians: "If Aristotle and Galen are both of one mind we may be sure of the truth; but if they differ, it is very difficult to determine what is true."

Systems of medical doctrine, which profoundly influenced practice, were thus constructed upon the basis of speculation and traditionalism. The Galenic system held sway for nearly fifteen hundred years, and was displaced by other systems which, although marking an advance in knowledge, rested largely upon dogma. The eighteenth century is often characterized as that of the great medical systematists, and during the first four decades of the present century German medicine was bound in the trammels of the so-called philosophy of nature. The greatest factor in releasing medicine from the shackles of dogma and turning it into the paths of science, was the foundation of cellular pathology by Virchow in the middle third of the present century.

It is of course not to be inferred that the exercise of reason, logical deduction and imagination is not essential to fruitful scientific inquiry. Indeed, it may well be, as pointed out by Clifford Allbutt in his admirable address on "Medicine in the Nineteenth Century," that we could learn much from the old dialecticians in the use of the weapons of logic, but experience has demonstrated that the real basis of progress in medicine, as in all the natural sciences, is the discovery of new facts by means of observation and experiment. It is by following the path thus indicated that medicine has advanced with such rapid strides during the latter half of the present century.

These great advances in medical knowledge, secured by the employment of truly scientific methods of investigation, have largely increased and modified the material needs essential for the promotion of medical science and for proper systems of medical education. It is of the highest importance that the general public, at least in this country, should be informed of the necessities of medical teaching and investigation, for if they want good doctors they must help to make them.

Medicine can no longer be adequately taught by the simple appliances of former times. As long as medical knowledge was essentially a body of tradition, about all that was necessary in the way of material equipment was a lecture room. Until comparatively recent times, the student was brought into direct contact with the objects of study only in the dissecting room and occasionally in the clinical amphitheatre. Gross human anatomy, being for centuries the only subject which the medical student could study by laboratory methods, acquired an exceptional position in the scheme of medical education. At the present time, instead of a single laboratory subject, there are at least eight subjects which require special laboratories or divisions of laboratories, and some of these are no less important than normal anatomy. These subjects are microscopic anatomy and embryology, physiology, physiological chemistry, pharmacology, pathology, bacteriology, hygiene and clinical microscopy.

The lecture room no longer holds the dominant position. While the purely didactic lecture still has its place in medical teaching, this place is relatively a subordinate one.

It is important that the student should be brought into closer relation with the patient than was formerly the case. It is not sufficient that he may witness from a bench in the amphitheatre a surgical operation or the examination of a patient. He should be admitted to the dispensary and to the hospital wards, and should have opportunity to make personal examinations in cases of disease, and to follow the course and management of medical, surgical and obstetrical cases. He should be subjected to practical tests of his knowledge and power before he is launched upon the community as a qualified practitioner.

Now all of this requires suitable preliminary education, a period of professional study of at least four years, many and well-equipped laboratories, hospitals controlled by the medical schools or at least conducted in sympathy with the needs of medical education, and a large body of well-trained teachers. The greatest, although by no means the sole, difficulty in meeting these requirements of higher medical education has been the establishment of suitable laboratories. While we have a few good laboratories, there is no medical school in this country fully provided with all the laboratories which it needs, and there is no single medical laboratory which possesses an endowment adequate to its needs.

A properly equipped laboratory requires suitable work rooms, a corps of trained teachers and attendants, supply of the material to be studied and of all the instruments, reagents and appliances needed for this study, access to books and journals, and funds for the purchase of fresh supplies and new instruments when needed.

The construction, equipment and organization of a first-class medical laboratory involve an outlay of money beyond the resources of a medical school dependent for its existence solely upon the fees of students, even when combined with the generous gift by the teachers of their services. In the state-supported universities of Germany three times as much money is devoted to the maintenance of laboratories as to the salaries of teachers. All honor to our own medical schools which, without the aid of state or of private endowment, are doing their best under great sacrifices to meet, so far as is within their power, the needs of modern medical education by provision for laboratory instruction and research! Of this generous and enlightened policy we witness a notable example here tonight in the opening of this building with its well arranged laboratories.

The most remarkable progress in medical education in this country during recent years has been along the lines of more extended and improved methods

of laboratory teaching, and I am inclined to think that the instruction in the scientific subjects of the first two years of the medical course, which was formerly the weakest, is now the strongest feature of our system of medical education. Those engaged in teaching these scientific subjects give in general a much larger share of their time to the work of instruction than do the teachers in the practical branches, and their courses are often better organized and more efficient than the clinical courses. The real aim of medical education should be the training of practitioners of medicine and surgery, and the benefits of thorough grounding in the fundamental medical sciences are to a large extent sacrificed if the student does not find in the latter two years of his undergraduate study well-conducted clinical courses which afford opportunity for the practical application of knowledge previously acquired in the laboratories.

This is not a suitable occasion to consider the difficult problems pertaining to the arrangement of the medical curriculum. The entire content of medical knowledge is now so vast that only a relatively small part of it can be taught during the period of undergraduate study. Exactly what subjects shall be taught, in what order and how they shall be taught, and what amount of time shall be devoted to each are important matters, but they lie outside of my present theme. Of this much I am convinced, that it is of the first importance to impart to the student something of the scientific spirit, a real, living knowledge of the subjects studied, and the power to use the instruments of his profession. Thus trained, it lies within his power to continue an education which can only be begun at the medical school. It is in these directions that the educational value of laboratory methods, whether employed in the laboratory proper or in the hospital, is the greatest. In the laboratory the student learns the fundamental importance of accurate observation and experiment, here he finds that only that knowledge is living and stays by him which comes from direct contact with the object of study, and not from being told about it, or reading about it, or merely thinking about it, and here he becomes acquainted with methods and instruments essential for diagnosis, and, therefore, for intelligent treatment of disease.

There is or should be no real distinction in the spirit and methods of study between the laboratories of medical science and the hospital wards. One of the most important directions of development in our modern hospitals has been their close alliance with laboratories. The establishment of clinical laboratories in connection with hospitals has been, on the one hand, a great relief to other laboratories, and on the other, has conduced to improve diagnosis and more careful study of cases of disease, and has supplied admirable opportunities for the instruction of students. The resulting benefits to the patient have been inestimable.

As I have already indicated, the development of medical laboratories, from their modest beginnings with those of Purkinje and of Liebig in the second decade of this century, has been the natural and inevitable result of the genuine scientific spirit, which distinguishes nineteenth century medicine from all that preceded it, and which has made it a biological science. The important discoveries in medicine during the century have been, on the one hand, the incentive to the foundation of laboratories, and on the other hand, and in still larger measure, have been the outcome of activities within laboratories.

While the expenses of a first-class laboratory are considerable, if we could estimate the benefits to mankind derived from investigations conducted in medical laboratories, all of the money ever expended for laboratories would seem in proportion to these benefits very insignificant. While it would be absurd to attempt to estimate in money the value of scientific discoveries, it would not be difficult to show that all the money ever expended for the promotion of medical and biological science has been repaid a thousandfold by the results of laboratory investigations in one department alone, namely, that relating to microscopic organisms, as witness the rescue of the silk-worm industries of France by Pasteur's studies, the advantages to breweries, dairies and agriculture from the study of fermentative processes, the introduction of antiseptic surgery by Lister on the basis of Pasteur's discoveries, the saving of untold thousands of human and animal lives by preventive and curative inoculations in diphtheria, rabies, anthrax and other infectious diseases. The most important of the discoveries which have led to such results as these, and have opened up new vistas in medicine, have been made in Germany and France, where scientific laboratories are most numerous and best supported.

The last two decades of this century have been periods of unsurpassed fruitfulness in medical discovery. There is no reason to suppose that this activity will not continue and bring forth results beside which our present attainments will appear small. What patriotic American would not rejoice to see his country take a position commensurate with its size and importance in this great forward movement of medical and biological science? The surest and probably the only way to secure such full participation upon our part, is by the endowment of medical education and research.

There may have been in former times little that was attractive to the philanthropist in the endowment of medical education. While the students of medicine greatly outnumber those of theology, and the expenses of medical far exceed those of theological education, the endowments of the latter in this country exceed $20,000,000, whereas those of medical schools are less than $1,000,000. The Commissioner of Education, in his report

for 1890-91, commented as follows upon this contrast between the endowment of theology and that of medicine:

"There can be no doubt of the propriety of private philanthropy endowing theological study, nor of the state's enterprise in supporting technical and pedagogical studies, but it is difficult to discover why such consummately practical and important topics as law and medicine should be neglected by private benevolence or public caution. It seems to be conceded that unendowed instruction in law or medicine will be just as poorly given as unendowed instruction in theology or pedagogy. Yet we find instructors in both these sciences, though necessarily state-supported on the Continent of Europe, in America left to live upon the meager diet of tuition-fees."

The needs of medical education have begun to be recognized by public-spirited philanthropists. I believe that there is today no direction in which private philanthropy can secure larger returns in benefits to humanity than by money expended in improvement of medical education and in the promotion of medical knowledge. Certainly it is the duty of physicians to make clear to the public the urgent needs of medical education, and if these needs are fully appreciated, it cannot be doubted that the small number of benefactors of medical education will be increased.

In conclusion, I desire to express my warmest congratulations to the faculty, alumni and students of the College of Physicians and Surgeons of Baltimore upon the addition to their resources of this admirable building, which has been constructed with full appreciation of the value of laboratories in the training of medical students. Its completion is a matter of congratulation not to this college alone, but to the city of Baltimore and to all interested in the promotion of medical education. May this structure, now opened, long be the abode of sound learning, of good teaching, of active work, an attraction to students from far and near!

LABORATORY METHODS OF TEACHING[1]

The value of laboratory methods of teaching is now so generally recognized that it may not be out of place to speak of some of their shortcomings. They are extremely timetaking, and are not adapted to present the entire contents of any subject. Their great service is in developing the scientific spirit and in imparting a living, abiding knowledge, which cannot be gained by merely reading or being told about things. So important are these ends, that it seems difficult to overestimate the value of the laboratory in scientific teaching. But there are aspects of every subject, even of such best fitted for laboratory instruction, which it is important for the student to learn, but which, either from lack of time or from the nature of the subject-matter, cannot readily be taught in the laboratory. The attention of the student in the laboratory is likely to be concentrated upon isolated facts, especially those most susceptible of easy demonstration to classes, while other groups of facts and particularly broad general principles are in danger of being lost to view. There is, therefore, risk of loss of perspective in relying solely upon instruction in the laboratory. Hence, I have found it desirable to supplement the laboratory work by didactic and demonstrative lectures. Recitations are also valuable in systematizing the work of the student, in rendering his knowledge more precise, and in affording opportunity to the teacher to clear up difficult or obscure points.

The methods of instruction followed in any particular department are left, with us, practically to the discretion of the head of that department. Some give no didactic lectures, others give a few, and still others make more extensive use of them. If a teacher is convinced that didactic lectures are useless, it is not likely that his lectures will be of much value, and it may be as well for him to dispense with them.

Our first two years of instruction are devoted to the fundamental medical sciences, and during this period most of the teaching is in the various laboratories. Near the end of the second year the students are taught the methods of normal physical diagnosis, so that they are prepared to take up at the beginning of the third year the clinical study of disease. During the last two years the dispensary and the wards of the hospital occupy the same relative position in the scheme of instruction as do the anatomical, physio-

[1] Report of remarks made before the American Surgical Association at a meeting held in The Johns Hopkins Hospital, Baltimore, May 8, 1901.

Tr. Am. Surg. Ass., Phila., 1901, XIX, 219-222.

logical, pathological, and other laboratories in the earlier period. We have found great advantage in the establishment of clinical laboratories, where, during the clinical years, the students are thoroughly trained in the application of microscopical and chemical procedures to the diagnosis and clinical study of disease. These technical procedures can be taught best by those frequently engaged in using them, and at a time when the student can appreciate their importance; and it is a great relief to the courses in the earlier years, particularly those in bacteriology and pathology, to be freed from the necessity of including these practical topics.

Every student during each year of his medical course is obliged to have a microscope, and if he does not own one, he rents one for a price which covers the interest on the investment and repairs. This microscope is his property for the year; he uses it in different courses, and he can take it to his home. The laboratories are open to the students throughout the day, and he can spend his spare time at his desk.

Any student who chooses to take up some small piece of original or advanced work is encouraged to do so, for the educational value of such work is very great. The number of those who have real capacity for independent research and the creative faculty is, of course, small, but it is of the highest importance to recognize and encourage this rare talent when it exists.

Our pathological laboratory was in operation before the establishment of the hospital and both were active before the opening of the medical school. This resulted in the establishment of an unusually close relationship between the work of the laboratory and that of the hospital, which has been of great mutual advantage. From the start the pathological service has been recognized as an integral and essential part of the hospital, coordinate with the clinical services. We have pathological internes ranking with the clinical internes and it cannot be doubted that this arrangement has greatly promoted the scientific work of the hospital and given to it one of its most distinctive features.

We have tried to keep in view that it is the function of a great medical school not only to teach, but also to advance knowledge. In the selection of teachers for this double function it is as important to consider their productive capacity as their powers of imparting knowledge, and I do not think it happens as often as it is sometimes represented that a fruitful investigator is not at the same time a good teacher.

There is one inquiry which I should especially like to bring before this body of leading surgeons of this country, and that is, Whether the opportunities for training and advancement in clinical medicine and surgery in this country have kept pace with the progress of medical science in the same measure as have those open to young men seeking the higher careers in

anatomy, physiology, pathology, and the other purely scientific branches of medicine? The laboratory side of medical teaching has now, I believe, in our leading medical schools advanced from the weakest to the strongest feature of our curriculum, and if after graduation a young man chooses for his career one of these scientific branches, he can find the opportunity to secure an excellent training in this country, and after serving as an assistant in a laboratory, and winning a reputation by his published work, he can look forward to securing a desirable position as head of a laboratory. For such positions our schools seek the best men wherever they can find them, and are not limited to the choice of home talent.

Are there similar opportunities for prolonged thorough training in clinical medicine and surgery after graduation and for promotion? We afford such an opportunity here to a few men who are fortunate enough to secure the more permanent resident positions over the regular internes, but in general the hospitals of this country are so organized as not to offer like opportunities to those seeking the higher careers in medicine and surgery. In consequence of what I believe to be a defective organization of our hospitals, the young clinician with high aims does not find opportunities for acquiring experience and making a reputation analogous to those available to anatomists, physiologists, and pathologists. Did time permit, it would not be difficult to show that the work of the hospital also suffers thereby.

Furthermore what chance is there that a man who has made a high reputation in clinical medicine or surgery in one place will be called to a desirable position elsewhere? In consequence of the relation usually existing between our hospitals and medical schools and for other reasons, our schools restrict themselves to the selection of local physicians and surgeons for their important clinical chairs to a much greater extent than in the choice of anatomists, physiologists, and pathologists. Hence it is that clinical medicine and surgery in their higher fields do not offer to young men the opportunities and attractions in this country which they should do, and which they do in Germany and some other foreign countries.

In conclusion, I beg to say that our laboratories are open for your inspection, and we shall be glad to see any of you there. We have had no money to put on external adornment, but we have a very fair equipment for actual work and good facilities for instruction.

THE BENEFITS OF THE ENDOWMENT OF MEDICAL RESEARCH [1]

The support of hospitals has always made a strong appeal to the philanthropy of the state and of individual citizens, and the importance to the community of educated physicians has been appreciated, although in this country until recent years most inadequately, but the recognition of medical science as a rewarding object of public and private endowment is almost wholly the result of discoveries in this department of knowledge made during the last quarter of a century. An eloquent witness to the awakening of this enlightened and beneficent sentiment, is the establishment, in 1901, of the Rockefeller Institute for Medical Research with its laboratories formally opened today.

While the scientific study of infectious diseases is, of course, not of recent origin and had been pursued as a part of the functions of health departments and of university laboratories of hygiene and of pathology, the first provision of a special laboratory for this purpose was made by the German Government in 1880 in the Imperial Health Office in Berlin, and to the directorship of this laboratory was called from his country practice Robert Koch, who four years before had startled the scientific world by his memorable investigations of anthrax. The supremacy of Germany in science is due above all to its laboratories, and no more fruitful record of scientific discoveries within the same space of time can be found than that afforded by this laboratory during Koch's connection with it from 1880 to 1885. Thence issued in rapid succession the description if those technical procedures which constitute the foundation of practical bacteriology and have been the chief instruments of all subsequent discoveries in this field, the determination of correct principles and methods of disinfection, and the announcement of such epochal discoveries as the causative germs of tuberculosis—doubtless the greatest discovery in this domain—of typhoid fever, diphtheria, cholera, with careful study of their properties.

The leading representative, however, of the independent laboratory devoted to medical science is the Pasteur Institute in Paris founded in 1886 and opened in 1888. The circumstances which led to the foundation of

[1] **An address delivered at the Formal Opening of the Laboratories of the Rockefeller Institute for Medical Research, New York City, May 11, 1906.**

Johns Hopkins Hosp. Bull., Balt., 1906, XVII, 247-251.

this institute made probably a stronger appeal to popular sympathy and support than any others which have ever occurred in the history of medicine.

There stood in the first place the personality and the work of that great genius, Louis Pasteur, of noble and lovable character, one of the greatest benefactors of his kind the world has known, who for forty years had been engaged, often under adverse conditions, in investigations which combined the highest scientific interest with important industrial and humanitarian applications. Pasteur's revelation of the world of microscopic organisms in our environment—the air, the water and the soil—and his demonstration of their relation to the processes of fermentation and putrefaction had led Lister in the late sixties, even before anything was definitely known of the causative agency of bacteria in human diseases, to make the first and most important application of bacteriology to the prevention of disease by the introduction of the principles of antiseptic surgery, whereby untold thousands of human lives have been saved.

In 1880 came the most momentous of Pasteur's contributions to medical science and art in the introduction of the method of active immunization by the use of the living parasites of the disease attenuated in virulence, a method which until this date had remained without further application since its employment by Edward Jenner in 1796 in vaccinating against smallpox. Pasteur's researches in this field of immunity, marvelous in their originality, ingenuity and fertility of resource, culminated in 1885 in the announcement of his successful method of protective inoculation against that dread disease, rabies, and most of those here present will recall the enthusiasm with which this great triumph of experimental medicine was hailed throughout the civilized world.

It was under the immediate impression and the incentive of this discovery and as a mark of gratitude to Pasteur that over two and one-half million francs were raised within a short time by international subscription for the construction and endowment of an institute to bear his name, where the Pasteur treatment was to be carried out and ample facilities afforded for investigations of microorganisms and the problems of infectious diseases. This model institute, much enlarged since its foundation and after the death of Pasteur under the directorship of Duclaux and now of Roux and, in one of its most important divisions, of Metchnikoff, has been a fruitful center of productive research and through its contributions to knowledge affords a signal illustration of the benefits to science and to humanity of the endowment of laboratories for the advancement of medical science.

It was under much the same influences that the important Imperial Institute for Experimental Medicine in St. Petersburg, with even wider scope than the Pasteur Institute, was founded and munificently endowed by Prince Alexander of Oldenburg in 1890.

In the following year the Prussian government established in Berlin under the directorship of Professor Koch the admirably organized and equipped Institute for Infectious Diseases, to which is attached, as to the Pasteur Institute, a hospital for infectious diseases. This and the excellent Institute for Experimental Therapeutics in Frankfort, under Professor Ehrlich's direction, founded also by the Prussian government in 1896, are unsurpassed in their scientific activities and in the number and value of their contributions to our knowledge of infection and immunity.

In 1891 was founded in London the British, late the Jenner, and now the Lister Institute of Preventive Medicine designed to be a national institute similar in character and purpose to the Institut Pasteur in Paris. The funds were contributed by the public and subsequently increased by Lord Iveagh's generous gift of two hundred and fifty thousand pounds.

Within less than a year after the foundation of the Rockefeller Institute for Medical Research the Memorial Institute for Infectious Diseases was founded in Chicago by Mr. and Mrs. Harold F. McCormick, and placed under the capable direction of Professor Hektoen.

The Institute for the Study, Treatment, and Prevention of Tuberculosis which bears the name of its beneficent founder, Henry Phipps, was incorporated in Philadelphia in 1903, and, while devoted to a single disease, it must be ranked among those of wide scope, when we consider the magnitude and surpassing importance of the problems pertaining to this disease.

It may also be noted that the Carnegie Institution in Washington, with its unequalled endowment of ten million dollars, includes within its scope the support of biological and chemical investigations of great importance to medical science, so that our country now stands in line wth Germany, France and Great Britain in the opportunities afforded for research in medical and other sciences.

These various institutions have been mentioned as typifying the general aims and character of the Rockefeller Institute for Medical Research rather than to afford any complete picture of the material aid now available for the advancement of scientific medicine. If the latter were the purpose it would be necessary to travel far afield so as to include independent medical laboratories of more restricted scope, such as those for the study of cancer, the laboratories connected with departments of health, so well exemplified in our own country by those of the State Board of Health of Massachusetts and of the Department of Health of the City of New York, hospitals and the laboratories connected with them, the medical laboratories of universities and medical schools, such as the Thompson Yates and Johnston laboratories in Liverpool and the splendid new laboratories of the Harvard Medical School, laboratories established in recent years for the study of tropical dis-

eases, such as our government laboratories in Manila, and funds available for special grants to investigators.

Impressive and encouraging as is this remarkable growth within recent years of laboratories devoted to the medical sciences no one who has any knowledge of the vast field to be covered, of the difficulty and complexity of the problems, of the expenditure of money required, and the returns in increased knowledge and benefits to mankind which have been attained and which may be expected in increasing measure, can for a moment suppose that the existing opportunities, considerable as they are, are adequate to meet the present and the future needs of scientific medicine.

As I have already stated, the wider recognition of a medical science as a rewarding object of endowment is a result of discoveries made during the last quarter of a century, and it is of interest to inquire why this increased knowledge should have borne such abundant fruit. The result is not due to any change in the ultimate aims of medicine, which have always been what they are today and will remain—the prevention and the cure of disease, nor to the application to the solution of medical problems of any higher intellectual ability and skill than were possessed by physicians of past generations, nor to the growth of the scientific spirit, nor to the mere fact of a great scientific advance in medicine, for the most important contribution ever made to our understanding of the processes of disease was the discovery by Virchow in the middle of the last century of the principles and facts of cellular pathology, the foundation of modern pathology.

The awakening of this wider public interest in scientific medicine is attributable mainly to the opening of new paths of investigation which have led to a deeper and more helpful insight into the nature and the modes of prevention of a group of diseases—the infectious diseases—which stand in a more definite and intimate relation to the social, moral and physical well-being of mankind than any other class of diseases. The problems of infection which have been solved and kindred ones which give promise of solution are among the most important relating to human society. The dangers arising from the spread of contagious and other infectious diseases threaten not the individual only but industrial life and the whole fabric of modern society. Not medicine only but all the forces of society are needed to combat these dangers, and the agencies which furnish the knowledge and the weapons for this warfare are among the most powerful for the improvement of human society.

Great as was the material, intellectual and social progress of the world during the past century there is no advance which compares in its influence upon the happiness of mankind with the increased power to lessen physical suffering from disease and accident and to control the spread of pestilential

diseases. Were we today as helpless as the physicians of past centuries in the face of plague, smallpox, typhus fever, cholera, yellow fever and other epidemic diseases, even if the existence of our modern crowded cities were possible, which may be doubted, the people would sit continually in the shadow of death. Great industrial activities of modern times, efforts to colonize and to reclaim for civilization vast tropical regions, the immense undertaking to construct the Panama canal, are all in the first instance dependent upon the successful application to sanitary problems of knowledge, much of it gained in recent years, concerning the causation and propagation of epidemic and endemic diseases.

And yet probably a fair measure of the general realization of these facts is the provision by Congress that of the seven members of the Isthmian Canal Commission four shall be engineers, without a word concerning a sanitarian on the commission. There could hardly be a more impressive opportunity to demonstrate to the world the practical value of our new knowledge concerning the mode of conveyance of malaria and yellow fever, the two great scourges of Panama, than that afforded by the digging of the Isthmian canal. The sanitary problem is not surpassed in difficulty by the engineering problem but we may feel reasonable assurance that with the sanitary control in hands as trained and capable as those of Colonel Gorgas the ghastly experiences of the old French Panama Canal Company and in the construction of the railway will not be repeated.

To comprehend fully the degree and the character of the progress of modern medicine requires a kind of knowledge and a breadth of vision not possessed by the average man. He is concerned mainly with the prompt relief of his own ailments or those of his family. Of the triumphs of preventive medicine he knows little or nothing. With such dull matters as the decline in the death rate by one-half and the increase in the expectation of life by ten or twelve years during the last century he does not concern himself. He takes no account of the many perils which have been removed from his pathway since his birth, and indeed at the time of his birth, nor does he know that had he lived a little over a century ago and survived these perils he would probably be marked with smallpox.

While it is true that in the relief of physical suffering and in the treatment of disease and accident the progress has been great and the physician and the surgeon can do more, far more today than was possible to his predecessors, and while improvement in this direction must always be a chief aim of medicine, still it is in the prevention of disease that the most brilliant advances have been made. The one line of progress, that with which the daily work of the physician is concerned, affects the individual, the unit, the other, like all the greater movements in evolution, affects the race. It

has been argued with a certain measure of plausibility that the interference with law of the survival of the fittest assumed to be a result of the success of preventive medicine will bring about deterioration of the race. I believe the argument to be fallacious and that we already have sufficient experience to show that there need be no serious apprehension of such a result.

Before some acurate knowledge of the causation of infectious diseases was secured preventive medicine was a blundering science, not, however, without its one great victory of vaccination against smallpox, whereby one of the greatest scourges of mankind can be controlled and could be eradicated, if the measure were universally and efficiently applied. The establishment upon a firm foundation of the germ doctrine of infectious diseases, the discovery of the parasitic organisms of many of these diseases, the determination by experiment of the mode of spread of certain others, and the experimental studies of infection and immunity have transformed the face of modern medicine.

The recognition, the forecasting, the comprehension of the symptoms and lesions, the treatment of a large number of infectious diseases have all been illuminated and furthered, but the boon of supreme import to the human race has been the lesson that these diseases are preventable.

Typhus fever, once widespread and of all diseases the most dependent upon filth and overcrowding, has fled to obscure, unsanitary corners of the world before the face of modern sanitation.

In consequence of the knowledge gained by Robert Koch and his coworkers Asiatic cholera, to the modern world the great representative of a devastating epidemic, will never again pursue its periodical, pandemic journeys around the world, even should it make the start.

Of bubonic plague, the most dreaded of all pestilences, which disappeared mysteriously from the civilized world over two centuries ago, we know the germ and the manner of propagation, and, although it has ravaged India for the last ten years with appalling severity, it can be and has been arrested in its spread when suitable measures of prevention are promptly applied.

Typhoid fever, the most important index of the general sanitary conditions of towns and cities, has been made practically to disappear from a number of cities where it formerly prevailed. That this disease is still so prevalent in many rural and urban districts of this country is due to a disgraceful neglect of well known measures of sanitation.

To Major Walter Reed and his colleagues of the army commission this country and our neighbors to the south owe an inestimable debt of gratitude for the discovery of the mode of conveyance of yellow fever by a species of mosquito. On the basis of this knowledge the disease, which had been

long such a menace to lives and commercial interests in our Southern States, has been eradicated from Cuba and can be controlled elsewhere.

Another army surgeon, Major Ross, acting upon the suggestion of Sir Patrick Manson, had previously demonstrated a similar mode of incubation and transportation of the parasite of malaria, discovered by Laveran, and it is now possible to attack intelligently and in many localities, as has already been proven, with good promise of success, the serious problem of checking or even eradicating a disease which renders many parts of the world almost uninhabitable by the Caucasian race and, even where less severe, hinders, as does no other disease, intellectual and industrial activities of the inhabitants. It is gratifying that one of our countrymen and a member of the Board of Directors of this Institute, Dr. Theobald Smith, by his investigations of Texas Cattle Fever, led the way in the discovery of the propagation of this class of disease through an insect host.

The deepest impress which has been made upon the average death rate of cities has been in the reduction of infant mortality through a better understanding of its causes. The Rockefeller Institute by the investigations which it has supported of the question of clean milk and the causes of the summer diarrhoeas of infants has already made important contributions to this subject, which have borne good fruit in this city and elsewhere.

No outcome of the modern science of bacteriology has made a more profound impression upon the medical profession and the public, or comes into closer relation to medical practice than Behring's discovery of the treatment of diphtheria by antitoxic serum, whereby in the last twelve years the mortality from this disease has been reduced to nearly one-fifth of the former rate.

The most stupendous task to which the medical profession has ever put its hands is the crusade against tuberculosis, whose preeminence as the leading cause of death in all communities is already threatened. Sufficient knowledge of the causation and mode of spread of this disease has been gained within the last quarter of a century to bring within the possible bounds of realization the hopes of even the most enthusiastic, but it will require a long time, much patience and a combination of all forces of society, medical, legislative, educational, philanthropic, sociological, to attain this goal.

Time forbids further rehearsal even in this meagre and fragmentary fashion of the victories of preventive medicine. Enough has been said to make clear that man's power over disease has been greatly increased in these latter days. But great and rapid as the progress has been, it is small in comparison with what remains to be done. The new fields which have been

opened have been explored only in relatively small part. There still remain important infectious diseases whose secrets have not been unlocked. Even with some whose causative agents are known, notably pneumonia and other acute respiratory affections and epidemic meningitis, very little has yet been achieved by way of prevention. The domain of artificial immunity and of the treatment of infections by specific sera and vaccines, so auspiciously opened by Pasteur and Behring, is still full of difficult problems the solution of which may be of immense service in the warfare against disease. Of the cause of cancer and other malignant tumors nothing is known, although many workers with considerable resources at their disposal are engaged in its study. With the change in the incidence of disease, due at least in large part to the repression of the infections of early life, increased importance attaches to the study of the circulatory, renal and nervous diseases of later life, of whose underlying causes we are very imperfectly informed. There are and will arise medical problems enough of supreme importance to inspire workers for generations to come and to make demands upon all available resources.

In directing attention, as I have done, to some of the practical results of scientific discovery in medicine and in indicating certain of the important problems awaiting solution there is always the danger of giving to those unfamilar with the methods and history of such discovery a false impression of the way in which progress in scientific knowledge has been secured and is to be expected. The final victory is rarely the result of an immediate and direct onslaught upon the position ultimately secured. The advance has been made by many and devious and gradual steps, leading often, it might appear, in quite different directions, and mounted more frequently than not to secure a wider prospect, but without any thought of the final goal. The army contains a multitude of recruits drawn from the most various fields, the biologist, the chemist, the physiologist contributing their share to medical triumphs just as truly as the pathologist, the bacteriologist, the hygienist, the clinician. The inspiration has been the search for truth and joy in the search far more than any utilitarian motive. In the fullness of time comes the great achievement; the leader is hailed, but he stands upon the shoulders of a multitude of predecessors whose contributions to the result are often lost from view.

In full recognition of the dependence of success in the warfare with disease upon increase of knowledge the Rockefeller Institute for Medical Research was founded by the enlightened munificence of Mr. John D. Rockefeller, to whom we make grateful acknowledgment. Likewise to the broad sympathies and active interest of his son, Mr. John D. Rockefeller, Jr., the origin and development of this institute are largely indebted.

What has already been accomplished, as well as the general scope and aims of the Institute have been concisely indicated to you by Dr. Holt. My purpose has been to show, although of necessity most inadequately, that these aims relate to matters of the highest significance to human society, that the present state of medical science and art requires large resources for its advancement, and that the returns in benefits to mankind have been and will continue to be great out of all proportion to the money expended. May the hopes of the founder and of those who have planned this institute be abundantly fulfilled! May it contribute largely to the advancement of knowledge, and may the streams of knowledge which flow from it be "for the healing of the nations."

POSITION OF NATURAL SCIENCE IN EDUCATION[1]

Ladies and Gentlemen.—In behalf of the members of the American Association for the Advancement of Science and of the Affiliated Societies I thank you heartily, President Butler, for your cordial words of welcome, and I assure you and your colleagues that it is most gratifying to us to have the opportunity of meeting in this city and at this university.

It was not until nearly forty years after its foundation that this association met first in the City of New York, whereas this third meeting in New York follows only six years after the preceding one in the same place. These events in their periods of sequence indicate in a measure the rate of growth of science in this city and its increase of attractiveness to men of science. While for a century and more there have been eminent scientific men in New York City, it is, nevertheless, true that for a long period of time letters and science were not represented in this city in a degree at all commensurate with its position in other respects, and New York thereby lacked a note of distinction in its civic and educational life possessed by several smaller cities and even small towns in this country.

In recent years, indeed in the short interval since our last meeting here, the conditions have changed rapidly, and New York is taking a position in education and the promotion of science more nearly approaching its leadership in commerce and other material interests. The most powerful instrumentality in bringing about this great advance has been Columbia University with the influences which have gathered about it, and it is most gratifying to the members of this association to witness, where we are now assembled, the marvelous growth of this great university. A worthy share in this development of the higher learning has been borne also by New York University, and in our visit to the new buildings of the College of the City of New York, where a general meeting of the association is to be held on Saturday, we shall have the opportunity to behold the visible evidences of the most enlightened liberality of a municipality in support of higher education for the people.

Those interested in natural science will find nowhere a more impressive illustration of municipal liberality in support of an institution for the instruction of the people and the advancement of natural knowledge than the

[1] Report of an address in response to the address of welcome, delivered as presiding officer of the 57th meeting of the American Association for the Advancement of Science, Columbia University, New York City, December 27, 1906.

Proc. Am. Ass. Adv. Sc., Wash., 1906-07, LVI-LVII, 617-622.

American Museum of Natural History, where on Saturday evening we are to be the guests of the trustees of the museum and of the Council of the New York Academy of Sciences, this latter organization ranking also among the important forces contributing to the development of science and of the scientific spirit in this city, and adding much to the interest of our meeting by the admirable exhibition and demonstrations of recent scientific progress which it has arranged in the museum. No feature of our meeting will afford greater pleasure and inspiration than the ceremonies attending the unveiling of the busts of American men of science presented to the museum by Mr. Morris K. Jesup, to whose generosity, public spirit and individual efforts American science is so deeply indebted. I wish to acknowledge at this time the courteous thoughtfulness of the trustees of the museum not only for their hospitality but also for selecting the time of our meeting for these interesting ceremonies.

The Metropolitan Museum of Art, with its magnificent collections of art and archeology, like the American Museum of Natural History, sets an example to the national government in the cultivation of the sciences and the fine arts.

Our botanical members at their meeting at the New York Botanical Garden will find there, as well as in the adjacent Zoological Park, in the opportunities afforded for the study of science and for the delight of the people, another and kindred illustration of the wise liberality of this city.

The New York Public Library, with its magnificent new building approaching completion, is another splendid foundation, resting upon both private and public munificence, which ranks among the great educational institutions of this city, whose growth and widened usefulness in recent years are significant of the progress of learning and science.

The holding of meetings of one of our sections and of affiliated societies in the new building of the Rockefeller Institute for Medical Research will afford opportunities to inspect laboratories unsurpassed in their arrangement and equipment for investigation in those branches of medical science to which they are devoted. In this connection I may state that New York City leads the world in the application by its department of health of the great discoveries of the last quarter of a century in bacteriology to the prevention of disease.

Time forbids further illustration of recent scientific progress in New York City. I have cited as examples mainly institutions with which the association will be brought, during our meeting, into some personal contact through their hospitality, and they will suffice to demonstrate the rapid and most gratifying development of higher education and of interest in the sciences of man and of nature in this city.

President Butler in his opening remarks has touched upon a subject most timely and important for the consideration of such men and women as constitute the membership of this association, and we shall do well to ponder carefully words on this theme coming from so high an authority upon education. While expressing sympathy with the aims of the natural and physical sciences, recognizing their importance and supporting them, as he has done, he also expresses the opinion that science in the general scheme of education and as an educational instrument has not fulfilled the expectations which he and others entertained regarding it a quarter of a century ago. While it is not possible to discuss this subject adequately on this occasion, I may be permitted to say a few words regarding it.

It is doubtless true that during the relatively short time since the natural sciences were admitted to the curriculum of a liberal education the teaching of these sciences has not attained to that agreement of opinion and fixity of method which centuries of use as instruments of education have secured for the classical languages and mathematics. It must be admitted that methods of teaching the natural sciences have often been unsatisfactory and have, therefore, yielded unsatisfactory results. The subject is one for serious consideration, to which many of our teachers are, I think, alive, and it is a satisfaction to announce that the council at its meeting this morning, in response to a wide-spread and influential demand, recommended the formation of a new section of this association to be called the "section on education," which we may hope, will contribute to the best methods of teaching the sciences.

It may also be admitted that exaggerated claims have sometimes been made as regards the position which the natural sciences should hold in the scheme of general education and as regards the extent and kind of mental discipline, culture and knowledge which, when pursued in such a scheme, they are capable of imparting. Without attempting to assign to these sciences their exact share in a plan of liberal education, and this share, I need hardly say, I deem an important one, I should be sorry to see eliminated from the education of even those looking forward to scientific pursuits the study of the languages, history and philosophy, which give a culture not to be derived solely from the study of the natural sciences and which should add greatly to the intellectual pleasure, satisfaction, breadth of vision and even efficiency of the man of science. Natural science should take its place in a plan of liberal education by the side of the older learning, the so-called humanities; each affords a kind of culture not to be obtained from the other, and any scheme of higher education which does not recognize the equal value of both kinds of culture is one-sided.

The full recognition of the part thus assigned to natural science in liberal education requires an adjustment on the part of the exclusive advocates of the traditional system handed down from the middle ages to new ideals of what constitutes liberal training, but in this field science has won its victory and will not be dislodged. It is, however, not enough to be content with this victory. Science should see to it that in its own field it becomes an instrument of education certainly not less powerful than the older humanities, and President Butler has very properly urged the need of improvements in this direction.

Standing here, as I do, as a representative of medicine in an association devoted to all sciences of nature the relation of medicine to general science comes prominently to my mind. Medicine has been called the mother of sciences. There was a time when the leading cultivators of natural science were physicians and when the medical faculties of universities were the homes of about all the science that then existed. In subsequent history physicians have played no small part in the development of the natural and physical sciences. Such important contributors to physical science as Black, Young, Mayer and Helmholtz were all actively identified with the medical profession, and are important figures in the history of medicine as well as of physics. From the study of chemical and physical phenomena of living animals and of man, whether by chemists, by physicists or by physicians, have come important additions to the sciences of chemistry and of physics, and medicine is constantly finding new and important applications of chemical and physical discoveries. We realize today as never before the fundamental unity of the biological sciences, and answers to the deepest and most far-reaching problems of medicine, not less than of other biological sciences, are to be sought in the properties of living matter, wherever it exists, whether in plants or in animals or in man.

Medicine has during the past half century entered irrevocably upon the true paths of science. Dogma and transmitted authority are no longer its guides, but it seeks for truth by the only methods found fruitful for all science—experiment, observation and just inference.

The domain which has been opened to medicine during the last quarter of a century by the introduction of new methods and resulting discoveries in the causation of infectious diseases has greatly increased our power to cope with disease, and the masterful pioneers in this new field, Pasteur and Koch, rank among the greatest benefactors of mankind. The wider recognition by governments and by the people of the humane, the economic and the social value of this power of preventive medicine to check incalculable suffering and waste of energy from disease is urgent. One of the most gratifying exemplifications of the useful functions of this association is the

initiation by the section on social and economic science of an influential movement for the establishment by the national government of a bureau or department of public health.

This leads me, in closing, to say a few words concerning the scope and aims of this association. Our retiring president, in his introductory remarks, spoke of the great growth of the association, which has more than doubled its membership during the six years since we last met in New York. At its foundation and for many years afterward this association supplied all that was demanded of a national society representative of the various natural and physical sciences. In later years specialization, at once a cause and a result of the great progress of science, has led to the formation of many special scientific societies of national scope, and the end is not yet in sight. It became evident several years ago that the association, in order to retain its usefulness, if not its life, must adjust itself to the new conditions, and this it did by taking the position of a central organization of science with which the various special societies, while remaining autonomous, should become affiliated and constituent units. It cannot be doubted that the broad conception underlying this readjustment is the correct one and that its application has already been attended by a large measure of success.

There remain, however, certain difficulties to be overcome and certain problems to be solved before this association shall have attained that ideal of organization and of usefulness to which we may reasonably look forward. The need of such a central, national organization as a coordinating, unifying, harmonizing influence, as an authoritative representative and exponent before the public of scientific opinion and of scientific workers, as an instrument to secure cooperation among scientific investigators, to influence public opinion, to advance the interests of science as a whole as well as to inaugurate and to secure support for special scientific undertakings and lines of investigation, and as a means of securing that most desirable purpose, placed first among the objects of the association in its constitution, "to promote intercourse between those who are cultivating science in different parts of America"—the need, I say, of a central organization with these aims and others which might be specified demands, I think, a wider and deeper appreciation among the scientific men and women of this country. Especially should our leaders in science realize, as many of them do, the great possibilities of usefulness of this association and work actively for the promotion of its welfare. Larger financial resources are needed to perfect the organization and to enable the association to cultivate more fruitfully the fields which it already occupies and to enter new ones. Within the near future the membership should rise to at least ten thousand. With its history of honorable achievement and its present success this association

may confidently look forward to a future of greatly increased power and usefulness for the advancement of science.

I now declare open this fifty-seventh meeting of the American Association for the Advancement of Science, and in so doing I express the hope, which our program indicates to be indeed an assurance, that the sessions and social functions of the association, of the various sections and of the affiliated societies may be full of interest, pleasure and profit to those in attendance.

MEDICINE AND THE UNIVERSITY[1]

I believe that I make no mistake in assuming that the honor of the invitation to deliver this address came to me mainly through the official position which I chance to hold in the Association for the Advancement of Science and the desire to give prominence on this occasion to the sciences of nature in view of the approaching meeting of the association in this place. I must, however, disclaim any especial competence to speak for these sciences, and I know not where there is less need in our country of emphasizing the importance and significance of the natural and physical sciences, or where the representatives of these sciences have brought higher distinction to themselves and to their university, than here in the University of Chicago.

The past century is memorable above all others for the gigantic progress of the natural and physical sciences—a progress which has influenced more profoundly the lives and thought, the position and prospects of mankind, than all the political changes, all the conquests, all the codes and legislation. In this marvelous scientific advancement in all directions the sciences of living beings and their manifestations have progressed as rapidly and have influenced the material, intellectual and social conditions of mankind as much as the sciences of inanimate matter and its energies. So far as the happiness of human beings is concerned, there is no other gift of science comparable to the increased power acquired by medicine to annul or lessen physical suffering and to restrain the spread of pestilential diseases, although what has been accomplished in this direction is small indeed in comparison with what remains to be achieved. Man's power over disease advances with increased knowledge of the nature and causes of disease, and this increase of knowledge has its sources in the educational system.

In asking your attention on this occasion to some of the conditions and problems of medical education and research, particularly in their relation to the university and to circumstances existing in this country, I am aware that the theme is trite and that I can add little that is new to its discussion, but the subject, however wearisome, requires ever renewed consideration so long as the conditions remain as unsatisfactory as at present and so many problems await final solution. Especially is it important that the nature of the problems should be realized by the teachers and authorities of our universities. I know that in this university much earnest thought has been given to questions of medical education, and wisely so, for I have every confidence that the medical department of this university, already doing such

[1] An address delivered at the Convocation Exercises of the University of Chicago, December 17, 1907.

J. Am. M. Ass., Chicago, 1908, L, 1-7.

good work, is destined to be a leader in the promotion of higher medical education and the advancement of medical knowledge on this continent.

The historical and the proper home of the medical school is the university, of which it should be an integral part coordinate with the other faculties. Before there was a faculty of law at Bologna or of theology at Paris there was a school of medicine at Salernum, which, as is well known, occupies an interesting and unique position in the history of the origin and development of universities. From this early period to the present day no other type of medical school has existed on the continent of Europe than that of the university, and this union has been of mutual advantage, the renown of many universities being due in large part to their medical faculties, and these receiving the fostering care and the ideals of the university.

It was under the influence of these sound traditions of the proper relation of medical teaching to the universities that the first medical schools in this country were founded, that the College of Philadelphia, now the University of Pennsylvania, in 1765; that of Kings College, now Columbia University, in 1767, and after somewhat longer intervals those of Harvard, Dartmouth and Yale. The model for these early schools was the medical department of the University of Edinburgh, which derived its traditions from the University of Leyden, as these in turn can be traced back to the great Italian universities of the sixteenth century. We can contemplate with much pride and satisfaction the early history of these first American medical schools, which, notwithstanding their feeble resources, were imbued with a spirit of high purpose and just recognition of the qualifications needed for the pursuit of medicine as a learned profession.

It is deeply to be regretted that their successors did not continue to build on such foundations as those laid by John Morgan, William Shippen and Samuel Bard, but rather adopted and carried much further the plan of the proprietary medical schools which originated in England in the latter part of the eighteenth century and attained their highest development there during the first three decades of the following century, after which the hospital medical schools of a type peculiar to that country gained the ascendancy. We can transfer from our shoulders, however only a minor part of the responsibility for the conception and establishment of the proprietary medical school, for the English form of this school was a harmless thing which never dreamed of conferring the doctor's degree and was regarded with disfavor by examining and licensing bodies.

The proprietary medical school, conducted for gain, divorced from any connection with a university and free from any responsible outside control whatever, empowered by the state to usurp the university's right of conferring the doctor's degree and at liberty to set whatever standards it chose for

obtaining this degree, which carried with it the license to practise, is a phenomenon unique in the history of education and a contribution to systems of education for which America is entitled to the sole credit. This is the type of medical school which prevailed in this country during the greater part of the nineteenth century, and familiarity has made it difficult for us fully to realize how anomalous and monstrous it really is. Even in the case of those schools which were united with a college or university the connection became in most instances so loosened as to be merely nominal and to secure practical autonomy to the medical school. In the common type of these schools there was no requirement of preliminary study worthy of the name, the only practical training was in the dissecting room and an occasional amphitheater clinic, and the degree and license to practise followed the passing of an easy examination after attendance on two annual courses of lectures lasting five or six months each, sometimes an even shorter period, the student hearing the same lectures each year.

It is needless to say that such conditions brought great reproach to American medicine and introduced evils from which we are not yet wholly free. Nevertheless the system, bad as it was, can be painted in too dark colors. The rapid multiplication of medical schools which followed the second decade of the last century was, although excessive, in response to the needs of a rapidly developing country pushing the boundaries of civilization ever westward. Still it would be difficult to find a sound argument for increasing the hardships of frontier settlements and struggling communities by a supply of poor doctors.

The main relief to the picture is that the results were not so bad as the system. Many of the teachers were devoted, able men who imparted sound professional traditions and whose personality in a measure remedied the defects of the system. The native force, ability and zeal of many students enabled them to overcome serious obstacles and to acquire in the course of time, in spite of adverse circumstances, a mastery of their calling, perhaps a resourcefulness engendered by these circumstances, for even under the best conditions education does not end with the modicum of knowledge imparted in school and college. Some were so fortunate as to be able to supplement their inadequate training by European study. But among those without foreign training who were entirely the products of American conditions not a few were the peers of their European contemporaries, such as Daniel Drake, Jacob Bigelow, John D. Godman, William Beaumont, Nathan Smith Davis, Samuel D. Gross, Austin Flint, Marion Sims and others who have left names illustrious in the annals of our profession. Native vigor and resourcefulness enabled such men to surmount defects of an educational environment to which the average man must succumb.

Most gratifying is the rapidity with which medical education has risen during the last two decades from the low estate to which it had sunk during the greater part of the past century in this country. Among the more important causes contributing to this result may be mentioned the operation of laws transferring and, in fact, restoring the licensure to practise from the medical schools to state boards of examiners, whereby worthless medical schools are crowded to the wall and out of existence and others have been compelled to raise their standards, the moral pressure exerted through an awakened sentiment for reform on the part of the organized profession and the better schools, closer union between medical school and university and the consequent interest of university teachers and authorities in the problems of medical education, the example set by a few schools of a high order, endowment—although very inadequate—of medical education, which formerly was almost wholly neglected as an object in need or worthy of private or public beneficence, the advancement of medical science and art, necessitating improved methods and higher standards of professional training, and a juster and wider appreciation of the significance of curative and preventive medicine to the welfare of the community.

The history of medical education in America is still in the making, but we now have a number of schools with high standards and adequate equipment capable of giving to students of medicine a professional education as good as that to be obtained in European universities. The best and most progressive schools are those in organic union with a university, and it seems clear that to schools of this type belongs the future of higher medical education in this country. Nearly twenty years ago in an address at Yale University I endeavored to set forth the advantages of the union of medical school and university, and, as addresses, fortunately for those in the habit of giving them, are soon forgotten, I shall here summarize what I conceive to be the more prominent of these advantages.

Of all professional and technical schools the medical, with its requirements for laboratories, hospitals and teaching force, is the most costly. A medical department of a university is much more likely to be the recipient of endowment funds than an independent school, and the university is a safer and more suitable custodian of such funds.

In manifold ways the environment of a university is that best adapted to the teaching and the advancement of medicine. The medical school needs the ideals of the university in maintaining the dignity of its high calling, in laying a broad foundation for professional study, in applying correct educational principles in the arrangement of the curriculum and in methods of instruction, in assigning the proper place and share to the scientific and the practical studies, in giving due emphasis to both the teaching and the investigating sides of its work, in stimulating productive research, and in

determining what shall be the qualification of its teachers and of the recipients of its degree. Most invigorating is the contact of medical teachers and investigators with workers in those sciences on which medicine is dependent—chemistry, physics and biology.

In the selection of teachers—a matter of the first importance—a university is in a superior position to secure the best available men wherever they can be found, regardless of any other consideration than fitness. Too often this choice has been determined in our medical schools by irrelevant influences and considerations and an outlook upon the world scarcely more than parochial in extent.

In the difficult matter of adjustment of professional training to conditions of collegiate education peculiar to our country there are manifest advantages in the union of medical school with university, especially where the periods of liberal and of professional study are made to overlap. Where the sciences adjuvant to medicine, as general chemistry, physics, zoology and botany, are included in the medical curriculum, as is done in the German and French universities, it is economical and highly desirable that they should be taught in the collegiate or philosophical faculty rather than that separate provision should be made for them in the medical faculty, where they do not properly belong.

The benefits of union of medical school and university are reciprocal, and not to the medical school alone. A good medical faculty, properly supported and equipped, is a source of strength and of renown to the university possessing it, and its work in training students and in extending the boundaries of knowledge greatly increases the usefulness of the university to the community. Nor is there anything in this work which does not appertain to the proper functions of a university, however high its ideals. Indeed I venture to assert that the present and prospective state of medicine and its relations to the well-being of individual man and of human society are such that there is no higher or nobler function of a university than the teaching of the nature of disease and how it may be cured and prevented, and the advancement of the knowledge on which this conquest of disease depends. If it be said that the medical art is largely empiric, I reply that this, while true, does not make medicine unworthy of shelter in the university. The empiric method of discovery by trial and error has its glorious triumphs as well as the scientific and is not to be disdained. To it we owe such beneficial discoveries as the curative properties of quinine in malaria, vaccination against smallpox and the anesthetic uses of ether and chloroform.

But there is a scientific as well as an empiric side to medicine and the distinctive feature of modern medicine is the rapid extension of the former and the curtailment of the latter. The fundamental medical sciences—anatomy, physiology, physiological chemistry, pathology, pharmacology, bacteriology

and hygiene—are rapidly advancing and important departments of biological science, which have contributed and will continue to contribute enormously to the progress of practical medicine. In an address which I had the honor to deliver somewhat over ten years ago at the dedication of the Hull Biological Laboratories of this university I took occasion to dwell with some detail upon the biological aspects of medicine.

We should add to the specialized medical sciences already mentioned the study of the problems presented by the living patient in hospitals and laboratories attached to hospital clinics where chemical, physical and biological methods can be applied to the investigation of clinical problems which do not fall within the scope of other laboratories or can be less advantageously attacked in them. These clinical investigating laboratories are an important addition to the older analytical and statistical methods of study of disease and mark an advance from which valuable results have been obtained and more valuable ones are to be expected. It is highly desirable that our medical clinics should be organized with regard to this newer direction of work, for which they will require considerable funds.

The science of medicine has advanced in recent years more rapidly than the art and in its various branches it constitutes today a field of work most alluring and most rewarding to the properly trained scientific investigator, who, if he have the rare genius for discovery, may reap a harvest rich in blessings to mankind.

But the art of medicine has profited greatly by the application of scientific discoveries. The physician and the surgeon today can do far more in the relief of physical suffering and in the successful treatment of disease and injury than was formerly possible, but the great triumphs have been in the field of preventive medicine. The horizon of the average man's interest in medicine scarcely extends beyond the circumference of his own body or that of his family, and he measures the value of the medical art by its capacity to cure his cold, his rheumatism, his dyspepsia, his neurasthenia, all unconscious, because he does not encounter them, of the many perils which medicine has removed from his path through life. What does he know of the decline in the death-rate by one-half and the increase in the expectation of life by ten or twelve years during the last century? How many are there whose attention has been called to the significant fact that this increase in the expectation of life ceases with the forty-fifth year because we have as yet no such insight into the causes and prevention of the organic diseases of advancing life as we have into the manner of propagation of infectious diseases, which are responsible for the larger part of the mortality of the earlier years? The suffering and the waste of energy, money, production and human lives from preventable sickness and death are still incalculable,

but how little heed do legislators and authorities in our national, state and municipal governments pay to the appeals of physicians and enlightened economists to make adequate provision to check this waste! For this condition of things the medical profession is largely responsible in failing to enlighten the public and in shrouding its art with the mystery of an occult science, but it is beginning to rise to its high mission of public education in ways of preserving health and of preventing disease.

I have touched on these matters relating to the present and future state of the science and art of medicine, not with the view of recounting the achievements of modern medicine, but to indicate something of their importance to individual and to civic life and to show that in fostering the teaching and study of medicine the university finds a field worthy of its highest endeavors in the propagation of useful knowledge and in service to the community.

From what has been said we may, I think, assume with confidence that the best and in time the prevailing type of American medical school is destined to be that represented in medical departments in vital union with universities. In so far our system of medical education will conform to that of Germany and France, but in an important respect there is and will remain a difference due to the fact that in those countries the courses of study and the qualifications for the degree and the license to practise are moulded into practical uniformity by the regulations of the state. Nothing is more characteristic of the conditions of medical education in our country than the great diversity of the requirements and curricula of the various medical schools, even of those of the better sort. Entire uniformity is not to be expected and not to be desired, but at least such a measure of agreement should be secured as will permit students to pass freely from one university to another and to acquire, it is to be hoped, something of the habit of wandering which is such an enviable feature of student life in the German universities.

No problem of medical education in this country is so perplexing or has given rise in recent years to so much discussion and difference of opinion as that of the preliminary education to be required for the study of medicine. If I could announce a universally satisfactory solution of this problem, I should claim the honors of an important discovery, but as I cannot do so I shall forego on this occasion its detailed discussion, with a self-sacrificing forbearance which I trust may be commended by my hearers. It must suffice to enumerate the attempts at a solution, premising, what is generally recognized, that the difficulties arise from the anomalous development of the American college for many years, making it, however admirable it may be for certain educational uses, almost unadjustable to the needs of professional education.

The preliminary requirement of the bachelor's degree in arts or science should, in my judgment, carry with it the specification of collegiate laboratory training in physics, chemistry and biology, with a reading knowledge of French and German. These requirements have been in successful operation in the Medical Department of The Johns Hopkins University since its foundations in 1893, their adoption being necessitated by the acceptance of the terms of Miss Garrett's gift of endowment We are satisfied with the working of these requirements and would not lower them if we could, but it must be conceded that, while there is room for medical schools with these standards, the country is not ripe for their general adoption. The Medical Department of Cornell University has recently announced the intention to introduce similar requirements, and the Harvard University Medical School demands the bachelor's degree without the other requirements mentioned.

In order to meet the objection that the average age of graduation from our colleges is at least two years beyond that at which professional study usually begins in Europe, various attempts have been made to truncate the college course or to telescope a quarter to a half of it into the period of professional study, making one course of study count for two degrees. Manifest objections and embarrassments attend all of these attempts to find a suitable stopping place between the high school and the end of the college course. The plan adopted in this university to demarcate with some sharpness the first two years of the college course from the remainder and to exact the completion of these two years of study as the requirement preliminary to the study of medicine has much to recommend it under existing conditions. I learn from the last report of the Council on Medical Education of the American Medical Association that one medical school, the Medical Department of Western Reserve University, demands as a prerequisite to the study of medicine three years study in a college of arts and science, sixteen require two years of collegiate study, eleven of these schools being in the middle west or west, and thirty-one require one year, of these, nineteen being in the middle west or west.

The Council on Medical Education just mentioned, of which Dr. Bevan is the energetic and efficient chairman, has entered as a strong force for the elevation of standards of medical education in this country, and, while it has not the power of the British General Medical Council to make effective its recommendations, it can exert a most beneficial influence. It is significant that at its first conference, held in 1905, it recommended as the minimum preliminary requirement to be generally adopted by our medical schools an education sufficient to enable the student to enter the freshman class of a recognized college of arts or a university, and now it recommends that in 1910 to this shall be added a year's study of physics, chemistry and biology,

with one modern language, preferably German. The time has gone by when it is necessary to emphasize before an audience such as this the importance of laboratory training in physics, chemistry and general biology as fundamental to the successful study of medicine.

While it is not feasible to exact the preliminary study of the ancient classics, save some acquaintance with Latin, I feel that they are of value to the physician and that a liberal education and broad culture raise the influence and standing of the physician in the community, enhance and widen the intellectual pleasures of his life, instill an interest in the history of medicine and give him greater joy in the pursuit of a noble profession. It is important, especially for medicine, that this culture be imparted by methods of liberal education which do not blunt man's innate curiosity for the facts of nature.

There can be no more striking evidence of the progress of medical education in this country during the last quarter of a century than that it is no longer the laboratory, but the clinical side of medical teaching which offers the urgent problems. Only a few years ago the cry was the need of laboratories; now, while a sufficient supply of good laboratories is still beyond the resources of many medical schools, their value is fully recognized and all of our better schools possess them and are devoting probably as much of the time and energies of teachers and students to work in the laboratories as is desirable. There is even some risk, I believe, that a subject which can be studied with facility and advantage in a laboratory may acquire, on this account, a position in the scheme of medical studies disproportionate to its relative importance. The structure of organized beings, normal or diseased, for example, is eminently adapted to laboratory study, and for centuries normal anatomy had an educational value all its own, because it was the only subject which students were taught in the laboratory, whereas the study of function, certainly not less important, is much more difficult to approach by the laboratory method, and even at the present time normal physiology and especially pathological physiology do not receive the attention in medical education to which their importance entitles them.

It is interesting to note the impressions which Professor Orth of Berlin, an acute observer and most competent judge in all matters pertaining to medical education, received from his visit to this country three years ago regarding our laboratories and clinics. In an address conveying these impressions to the Berlin Medical Society he expresses his astonishment and satisfaction that, in contrast to the prevalent opinion in Germany as to our medical schools, he found that fully as much emphasis is placed on laboratory teaching here as there, that the laboratories which he visited are as good, their arrangements in some instances arousing his envy, and the methods

of teaching practically the same as in Germany, whereas he gathered the impression that the opportunities and methods of clinical teaching are less satisfactory than in Germany and not commensurate with those of our laboratories.

I do not desire to instill sentiments of undue complacency regarding the condition of laboratory teaching in our medical schools, for there is still room for much improvement in this regard. Many schools are sadly deficient and even the best have not all that is needed in the supply and maintenance of laboratories, but the time has come to give especial emphasis to directions of improvement in the teaching of practical medicine and surgery. The making of good practitioners should always be kept to the front as the prime purpose of a medical school.

I believe that in most medical schools at present the clinic falls behind the laboratory in affording students opportunities for that prolonged, intimate, personal contact with the object of study, in this instance the living patient, which is essential for a really vital knowledge of a subject. To secure this, amphitheater clinics and ward classes alone do not suffice, valuable as these are, but students under suitable restrictions and supervision and at the proper period in their course of study should work in the dispensary and should have free access to patients in the public wards or hospitals, acting in the capacity of clinical clerks and surgical dressers as a part of the regular, orderly machinery of the hospital.

In order to place the clinical side of medical instruction on the same satisfactory foundation as that of laboratory teaching, two reforms are especially needed in most of our medical schools.

The first is that the heads of the principal clinical departments, particularly the medical and the surgical, should devote their main energies and time to their hospital work and to teaching and investigating without the necessity of seeking their livelihood in a busy outside practice and without allowing such practice to become their chief professional occupation. This direction of reform has been forcibly urged in this city and elsewhere by my colleague, Dr. Barker, whom we have reclaimed from you, in notable papers and addresses.

The other reform is the introduction of the system of practical training of students in the hospital, which I have indicated, and with it the foundation and support of teaching and investigating laboratories connected with the clinics, to which I have already referred, necessitating the possession of a hospital by the medical school or the establishment of such relations with outside hospitals as will make possible these conditions. This subject, as thus outlined, I made the theme of an address at the opening, six months ago, of the new Jefferson Medical College Hospital in Philadelphia, and I

shall now recur only to the point which I endeavored there to establish, that the teaching hospital subserves the interest of the patient not less than that of the student and teacher and is the best and most useful kind of public hospital.

Hospitals make generally a stronger appeal to public and private philanthropy than the support of medical education, but I do not hesitate to affirm that a general hospital in a university city, whether maintained by public funds or by private benevolence, serves the community and the interests of its patients far better when it is readily accessible and freely available for the purposes of medical education than when it is divorced from connection with medical teaching. Witness the great public hospitals in Vienna, Berlin, Munich, Leipzig, Paris, London, Edinburgh, Dublin and a few in this country. It is most deplorable both for the hospitals and for the medical schools that these two institutions, which should be linked arms of medical education, should have developed in this country so far apart, that state and municipal authorities and private founders should have so little realization of the inestimable advantages which close association with a good medical school can confer on a hospital, and that the immense possibilities of public hospitals in our large cities for the education of students and physicians and for the advancement of medical knowledge should be utilized to so small an extent, often not at all.

It would be one of the greatest benefits to the cause of higher medical education if the University of Chicago, for its medical department, should come into possession of a good general hospital and fortunate the hospital which enters into this relationship. This university, the source of so many important contributions to the advancement of knowledge and of higher education, will then be, in larger measure than it now finds possible, a center of similar service to medicine.

Medical education partakes fully of the freedom, so amazing often to many of our European colleagues, with which we unhesitatingly try all sorts of educational experiments in this country—it is to be hoped and expected for the ultimate benefit of systems of education, whatever the immediate results may be in individual cases. The theme of this address naturally suggests many topics relating to methods of teaching and to the medical curriculum which are questions of the day, but which I must lay aside through lack of time. On one only I beg to say a few words.

In contrast to the German system the tendency in our American medical schools has been toward a rigid curriculum, which, though widely divergent in different schools, is to be followed in precisely the same way by all students without any consideration of differing ability, capacity for work, special aptitudes and interests. One of many unfortunate results is that

subjects and courses of study which cannot properly be imposed as obligatory on already overburdened students find no place in our medical schools, which should aim to cultivate the whole field of medicine. I agree with Dr. Bowditch and my colleague, Dr. Mall, to whose admirable presentation of this subject I would refer those interested, that our students should have a greater latitude of choice than is now customary in subjects to be pursued, in the amount of time to be devoted to their study and in the order in which they may be taken. Complete freedom cannot be granted. A minimum requirement for the principal subjects must be made obligatory, but if this minimum is properly fixed there remains room for a considerable range of choice of subjects and courses, greatly to the advantage of student and teacher. At the Harvard Medical School the system of electives for the fourth year of the course has been in operation for several years, and other medical schools have also introduced a similar plan. At the beginning of the current academic year we adopted at The Johns Hopkins Medical School a scheme by which a large number of elective courses are offered throughout the four years, and the plan is now working most successfully.

Some of our state boards of examiners are greatly exercised over the differences which they find in the curricula of the various medical schools in this country, and which in themselves are merely an indication that there is, and, in my judgment, there can be no agreement of opinion as to every detail of a medical curriculum. There are doubtless defects to be remedied, but in attempting to apply remedies these state boards should concern themselves with no other question than that of educational standards. They could make no greater mistake nor inflict more serious injury on the efforts of the better schools to improve their methods of teaching than to attempt to impose a uniform and rigid obligatory curriculum on all schools. They do not in their examinations apply any practical tests whatever to determine the candidate's fitness for the practice of medicine, whereas our better schools are exerting every effort to increase their efficiency by substituting practical work in laboratories, hospital wards and out-patient departments for didactic lectures. The work of students who gain their knowledge by serving as clinical clerks and surgical dressers in the hospital cannot be measured by time standards in the same precise way as that of attendance on expository lectures. Above all, the better schools should not be hampered by restrictions imposed by state boards of examiners in freedom to extend the system of electives of which I have spoken.

The medical department of a university should be a school of thought, as well as a school of teaching, *academia* as well as *schola*. Although there has been gratifying progress in recent years, our medical schools have not advanced along the path of productive research to the same extent that they have in the way of improvement of their educational work. There are sev-

eral reasons for this condition. For one thing we have been too busy setting our houses in order for their primary uses in the training of students to have given the requisite attention to other questions which, however important, may have seemed for the moment less urgent. With the degree of emphasis thus placed on the educational side teaching gifts rather than investigating capacity have been sought as the most desirable qualification of professors in our medical schools. The power of imparting knowledge, gained second-hand, fluently and even skilfully, is not an uncommon gift and is possessed by many who have never engaged in research and have no especial inclination or aptitude for it, but the teaching of him who has questioned nature and received her answers has often, and I think commonly, in spite it may be of defects of delivery, a rarer and more inspiring quality.

A medical school or university cannot expect to fill all of its chairs with men with the genius for discovery—if it has one or two it has a treasure beyond all price—but every effort should be made to secure as occupants of these chairs from among those who are available, wherever they can be found, the ones who have demonstrated the greatest capacity to advance knowledge by original investigation and the ability to stimulate research. Until this principle is more fully and generally recognized and acted on in the selection of heads of departments, our medical schools as a class will not become important contributors to knowledge. It is not enough that a few schools should encourage and provide for original investigation; the field must be a wide one in order to attract many to a scientific career, for of the many only a few will be found endowed with the power of discovery. There is no possible way of recognizing the possessor of this power before he has demonstrated it. Even when a university has succeeded in attaching to it those who can conduct scientific inquiry successfully, how often are their energies sapped by lack of adequate resources and enough trained assistants and by too great burden of teaching and administrative work imposed on them!

It is evident from what has been said, and indeed it has been a tacit assumption throughout this address, that, while with present resources considerable improvement in medical education in this country is possible, further progress is largely a question of ways and means. What makes modern medical education so costly is precisely its practical character, necessitating laboratories and hospitals, and it can be made self-supporting no more than any other department of higher education. For reasons already stated, the medical departments of strong universities are the ones most likely to receive the funds needed for the support of medical education and are in general the most deserving. There is a great future before the medical schools of many of our state universities, which are already developing with such

promise and are sure to receive in increasing measure aid from the state as their needs and the benefits accruing to the community from their generous support are more and more appreciated. Other universities must look to private endowment, and I have endeavored to show that they should foster their departments of medicine as zealously as their other faculties. The university chest should be opened, so far as possible, to supply needs of the medical school, and authorities of the university should present the claims of medical education to financial aid as among the most important in their domain, and they can do so today with a force of appeal not possible a quarter of a century ago. President Eliot, whose services to the cause of medical education are great, in his address at the opening of the new building of the Harvard Medical School, set forth with admirable force and clearness the changes which advancing medicine has brought in the vocation of the physician, his greatly increased capacity of service to the community and his still higher mission in the future.

The discoveries which have transformed the face of modern medicine have been in the field of infectious diseases, and in no other department of medicine could new knowledge have meant so much to mankind, for the infectious diseases have a significance to the race possessed by no other class of disease and problems relating to their restraint are scarcely less social and economic than medical. The public is awakening to this aspect in the case of tuberculosis, and I need only cite as a further example the necessity of keeping in check the malarial diseases and yellow fever for success in digging the Isthmian Canal, an undertaking in which the triumphs of the sanitarian, Colonel Gorgas, are not out-rivalled by those of the engineer. Such victories over disease as those of the prevention of hydrophobia by the inoculation of Pasteur's vaccine and the antitoxic treatment of diphtheria have made an especially strong impression on the public mind.

More than all that had gone before in the history of medicine the results achieved during the last quarter of a century in exploration of the fields of infection and immunity opened by the discoveries of Pasteur and of Koch have stirred men's minds to the importance of advancement of medical knowledge, and medical science at last has entered into its long awaited heritage as a worthy and rewarding object of public and private endowment. But it is to be noted that it is not so much the education of doctors as this advancement of knowledge which makes the strong appeal, as may be illustrated by the splendid foundation of the Rockefeller Institute for Medical Research through the enlightened generosity of the founder of this university, the Phipps Institute for the Study and Prevention of Tuberculosis, and the Memorial Institute for the Study of Infectious Diseases, established in this city by Mr. and Mrs. Harold McCormick, which under the efficient

direction of Dr. Hektoen has become a most active and important contributor to our knowledge of infection and immunity.

These magnificent additions to the resources of this country for the promotion of medical investigations are of inestimable value, but not one of them could have justified its existence by results if it had been established in America thirty years ago, when medical education was so defective. The dependence of research on education is of fundamental importance. The prime factor influencing the development of scientific research in any country is the condition of its higher education. Scientific investigation is the fruit of a tree which has its roots in the educational system, and if the roots are neglected and unhealthy there will be no fruit. Trained investigators are bred in educational institutions. Independent laboratories are dependent on a supply from this source, and without it they cannot justify their existence, but where proper standards of education exist such laboratories have a distinctive and important field of usefulness. I contend, therefore, that those interested in the advancement of medical knowledge should not be indifferent to the condition of education in our better medical schools and should not rest on the assumption that the educational side can be safely left to take care of itself.

Moreover, those who are to apply the new knowledge are physicians and sanitarians. The public is vitally interested in the supply of good physicians, never so much as today when their power to serve the welfare of the community has been so vastly increased and is rapidly growing, and if it wants good doctors it must help to make them.

I have been able, within the limits of this address, to indicate only a relatively small part of the increased strength gained by both medical school and university by the combination of their forces, but I hope that I may have conveyed some impression of the rich fields of discovery, of the beneficent service to the community, of the important educational work opened to the university by close union with a strong department of medicine, and of the inestimable value to medicine of intimate contact with the fruitifying influences and vitalizing ideals of the university. Where is there a university which, if provided with the requisite resources, gives stronger assurance of securing these mutual benefits than the University of Chicago, so fruitful in achievement during its brief but eventful history, so vigorous in its present life, so full of high promise for the future, and where in all this land is there a location more favorable to the development of a great university medical school than here in the City of Chicago? Such a development is bound to come and the sooner it arrives the earlier the day when America shall assume that leading position in the world of medical science and art assured to her by her resources, the intelligence of her people, her rank among the nations and her high destiny.

THE MEDICAL CURRICULUM[1]

The fundamental object of medical education is to make good doctors. Without question that should be the underlying conception in all schemes of medical education, and unless a given course of study bears on that training, it should have no place in the medical curriculum. If training in physiology even cannot be shown to help to make good doctors it is not defensible. The same can be said of pathology or any other subject in the curriculum. The ultimate aim of medical education is to make good practitioners of medicine.

Another inquiry confronts us in any consideration of a medical curriculum, What kind and what amount of knowledge can a student acquire during his four years of medical education?

It has been stated, and accurately so, that it is impossible to impart the entire content of medical and surgical science to the student. One cannot even impart the content of a single subject of the curriculum. The utmost to be expected is to give to the student a fair knowledge of the principles of the fundamental subjects of medicine, and a power to use the instruments and methods of his profession; to give him the right attitude toward his patients and his fellow-members in the profession; and above all to put him in a position to carry on the education which he has only begun in the medical school. Our aim therefore should be to put him in a situation to complete his education through the remainder of his life. With that point of view in mind, we cannot hope therefore to teach the student the entire contents of the science of medicine. The student cannot go out a trained practitioner, a trained pathologist, a trained anatomist, or a surgeon. Looked at from the point of view of knowledge alone, he has only a smattering. The training of his powers and methods of study are the important things. He should be put in a position to continue his own education.

Then again, after all, What is the curriculum? It is only a means to an end. It is the machinery and system—very important no doubt, but one may have an admirable system and very poor results. On the other hand one may have a bad system and secure good results out of all proportion to the excellence of the system. We have been shortsighted to a certain

[1] Report of an address delivered before the Association of American Medical Colleges, Baltimore, March 21, 1910.

Bull. Am. Acad. M., Easton, Pa., 1910, XI, 720-726.

extent in our criticisms of the old-fashioned medical schools. Notwithstanding the badness of the system the results were good out of all proportion. I was trained under that system myself. One, for example, could not sit under John Dalton without getting an education, an inspiration, and a stimulus for the rest of his life. It demands personality on the part of a teacher to make a system of any value, and we must not look on the medical curriculum as anything more than a method of attaining certain ends.

The tendency in late years has been to attempt to standardize the medical curriculum, but I would not consider that synonymous with fixing standards. Standardizing a curriculum designates what subjects shall be contained in it and how many hours or periods shall be devoted to each subject. There is great danger in such efforts. We are not in a position today to thus standardize our curriculum. If we attempt to do it, we imply that we have reached results more or less final in methods of education. We ought to recognize that we are at present only in a transitional stage of medical education. I think there is considerable danger in attempting to establish anything in the way of a rigid uniform curriculum. It is nothing short of a calamity for state boards of examiners to undertake in their requirements for licensure to state in detail the standards of a curriculum. Medical colleges should protest against efforts of that kind. There is no real advantage to be gained from such standardizing. I am very hostile to all efforts to make uniform standards, on rigid curricula, which will be applied to all medical schools. This, of course, could be elaborated very much, but I hope it does not require any arguments to make you sympathize with that point of view. This was the position which the Committee of the Council of the American Medical Association took in formulating their recommendations for a curriculum. They were finally led to offer their views as being merely suggestive. Of course, there is no objection to that; they may be very useful, but I would not give them any further weight of authority than that of mere suggestion.

The question as to what shall be the content of the medical curriculum is an important one. I think that the seven principal subjects still remain the backbone of medical education—anatomy, physiology, pharmacology, pathology, medicine, surgery, and obstetrics with gynecology, but with the growth of medical knowledge so many subjects have been added which are desirable to have represented in medical schools that at least we should furnish opportunities to students to study these subjects. It seems to me that we must include, therefore in the curriculum not only obligatory courses, but occasional or elective courses. Nothing is more attractive in the German universities than that almost everything in medicine can be studied. One can have special courses in this or in that subject. Of course, it is

beyond the possibilities for our average medical school to extend its curriculum so that it can include all these subjects. The medical schools which are in a position to do so should have the provision for training in all of the important subjects. Take, for instance, the subject of hygiene. It is impracticable to give all students thorough obligatory training in hygiene, and one should have much more than one gets today. The same thing may be said of the specialities. Hence the contents of the medical curriculum looked at as a combination of required and optional or elective courses, must be extensive and elastic.

I hope the time has come for nearly all the medical schools to exclude from the curriculum studies which are preparatory to the study of medicine, such as general chemistry, and physics. They have no place in the medical curriculum. Where the requirements for admission are not such as to include proper training in general chemistry, I dare say it is still necessary that it be taught in the medical school, but everybody must regard that as an impediment, and aim to exclude from the curriculum general chemistry and physics.

It is also my belief that the curriculum should not be too crowded, that the student should not be overburdened, so that he has no time for reading, for exercise of the body and for the digestion of knowledge. It has, long been the custom to make courses in the specialities come in the fourth year, and to make them more or less optional. At Johns Hopkins we have undertaken to extend such elective study throughout the four years of the course; which is, based on the idea that there is a minimum for certain subjects which all students must acquire. That portion of the work is obligatory and in giving to any subject a certain number of hours the problem is the same, What is the irreducible minimum in that subject without which one cannot let the student get his degree? That being fixed our effort is to provide in addition a number of elective or optional courses. They are quite extensive and run through the entire four years. Upon the whole, the students find this satisfactory and profitable and undoubtedly it is an improvement in the medical curriculum which can be adopted in the endowed medical school. Other medical schools must fix on an average curriculum which is adapted to their students, as well as to their opportunities and resources: but this does not represent the ideal; which is a much more elastic, comprehensive and fuller curriculum, where there are certain courses which are obligatory and a large number, running through practically all the years of the course, which are optional. They can be designated as minor and major courses and the student may be given the opportunity to take a major, say, in ophthalmology or pediatrics. Another student may want only a minor in these subjects, and a major in some other subjects. Only a small number of medical schools at present can construct

their curriculum according to these principles, but I present it to you for what I regard it to be the ideal curriculum, one which includes required and optional courses, some of which are minor and some major.

At The Johns Hopkins Medical School we have been led to the adoption of the trimester system and the student can enter on his work at any one of these periods.

As regards the arrangement of the curriculum, the general concensus of opinion is that the so-called laboratory subjects—most inappropriately called the scientific subjects, because medicine and surgery are equally scientific—should occupy the first two years, and the clinical courses the last two years. It is still an open question, Whether the student should not be brought into contact with patients at an earlier period? Whether there should not be some sort of clinical training? I think that the student in the second year should come into contact with patients. We are going to adjust our course, if possible, to this end, so that the student at the end of the second trimester of the second year will be introduced to clinical methods, practically, through physical diagnosis. This would enable him during his long vacation to do some work in the dispensaries. It would be a very decided improvement. In France the student begins with clinical work—an old-fashioned way; he comes into contact immediately with patients.

It is an open question whether we have not gone a little far in segregating scientific work, on the one hand, and the clinical work on the other hand. Should not students be brought earlier in contact with patients? One must send them out to practise medicine. That is the fundamental idea.

The character of the curriculum will depend much on the methods of teaching. Laboratory methods are extremely time-consuming and are applicable only for topics which admit readily of demonstration. The most creditable development in medical education is this country in the last two decades has been along the extension of the laboratory side. Twenty years ago this was the weakest part, today it is the strongest part of the curriculum.

It may however have become relatively too predominant. The weaknesses are not there; they are on the clinical side. We have gone farther in the direction of laboratory study that they have abroad. I do not consider it advisable to give any more time than we are now doing to the laboratory method which, superior as it is, has its defects. One can in that way teach only those parts of the subjects which are susceptible of demonstration in the laboratory. They are not the whole content of the subject. Take pathology, for instance; if all the student learned of it is what could be shown in the laboratory his knowledge would be fragmentary and lacking in perspective; he loses sight of the general principles. Such teaching must be supplemented to some extent by recitations, lectures, and reading,

so that the student will have a broader and more comprehensive view of pathology. We cannot devote more time than we are devoting today to laboratory methods. We must improve the curriculum in the clinical departments.

Of course the great need of our medical schools today is the proper relation to hospitals. It is certainly a most difficult thing to establish an entirely satisfactory relation between a medical school and a hospital, separately endowed, with independent management. If hospitals saw their interests, I think they would establish a closer relationship with the medical school. The ideal is for the school to have its own hospital, and that, I think, is the most urgent need of medical education today, so that students can study diseases at the bedside. This idea of having a rigid curriculum with fixed hours—How can it be made to apply where one assigns a student to the study of certain patients, where he can have free access to hospital wards at all hours of the day? This is the ideal. It is the best thing for the student, but the work is not divisible into hours. I do not see how one can express in terms of hours such training which is unquestionably the best of training. My plea is for a flexible curriculum, and not for an uniform, standardized, rigid curriculum, which one sets forth as an ideal. I think it is a mistake to aim at that; for it is my belief that we have not reached a period of medical education in this country where it is possible. You will all agree with me that it is very important to have the medical curriculum so constructed as to do away with cramming. The impetus to that is the existence of examinations for hospital positions and for state licensure; and although some of that may be a necessary evil, the student ought to be made broadly interested and enthusiastic in his subject. That is the keynote, and if one can inspire the student with real interest, it will be easy for him to learn. That is the kind of spirit we should try to inculcate in our students. The drill-master system of marks and examinations is, to my mind, a very objectionable one, and every effort should be made to do away with it. Give as few examinations as possible and let them include practical tests of the students' power.

The state boards of examiners have had their influence on the character of the medical curriculum. We all feel that the establishment of these examinations has been of very great value to medical education. It has crowded the poorer schools to the wall, and has raised the standards of those that survived. At the same time, we must feel that the character of the examinations today is not one which is adapted to develop the best sort of a medical curriculum. Our efforts should be to give students knowledge and power, not simply to cram their minds with facts. The state board examination does not bring out the essential quality because the examinations are not practical.

PREMEDICAL EDUCATION[1]

The problems of premedical education are extremely difficult. As I said last night this is due to the fact that our colleges develop without any reference to the needs of professional education. We are trying to straighten out these very serious conditions. It is necessary to ascertain, What shall be required, and also, what shall be the advice to give the students? A sound liberal education, without too strict thought of utilitarian purpose, including the application to medicine, should be advised. Of course, only a limited number of young men will be in position to acquire such an education, but they will have a far better position in the community, socially and otherwise, if they have a good liberal education with an arts and science degree. They will do better professional work and will derive a greater pleasure from it.

When we come to consider what the requirement should be, I do not think that the demand of an arts and science degree should be the standard, although we have this at Johns Hopkins. I believe there is room for one more institution with such requirement. I am also convinced that it is wrong to demand an arts degree without any specification as to what that should convey. Our requirement has never been copied by other institutions. It is not merely insistence upon an arts degree, but upon an arts degree with a year and a half or two years' work which belongs in the German university to the medical faculty. Students must come to us prepared, inasmuch as the college holds them a couple of years longer than it should. The college keeps them so long that it must supply the training in the natural and physical sciences which is fundamental to the study of medicine.

The preparatory colleges should give a reading knowledge of German and French. The demand that they must also send the student to the medical school with a year and a half or two years' preparation is entirely defensible. The step forward between the high school and the college course is not absolutely necessary, nevertheless it seems essential that some agreement should be reached. Two years of college work including a reading knowledge of French and German with the sciences seems to be on the whole the general trend of opinion, and our own opinion for a national standard.

There is a very unsatisfactory demand for collegiate training in this country. It is unfortunate that such a situation should exist. And probably the best remedy is to telescope the professional degree with the arts and science degree. I believe that this will have to be done. One year's work is quite inadequate in which to cover the field in chemistry, physics and biology.

[1] Report of an address delivered at the Conference on Premedical Education, University of Cincinnati, Cincinnati, Ohio, January 17, 1914.

Lancet-Clinic, Cincin., 1914, CXI, 117-118.

together with French and German. So far as these subjects are studied in college, it is best to study them for their own sake and not for their bearing on medical education. It is far better for the student to come with a general training in these subjects, than to try to pick out the parts bearing particularly on medical education. From this standpoint, I think there is nothing better than the Huxley method as taught in Johns Hopkins. Still it is admirable for preliminary education, if the teacher desires to instruct along the lines of zoology or botany, to let him be the judge in that respect. Such a question will be best determined according to the aptitudes and interests of the students.

It is necessary that the student should have some training in organic chemistry, otherwise when he undertakes chemistry as taught in the medical curriculum he will meet with much difficulty. In physics it is of the greatest importance that there should be a certain amount of preliminary training. Students will not come with a natural facility for French and German, but if they are placed in a position to continue their education in these subjects, reading some French and German every day, they will have been given enough for that purpose—about all that one can expect.

It would be inadvisable to attempt to standardize the course of study. The stronger medical schools are agreed that the state boards of examiners are endangering the progress of schools by too rigorously fixing a curriculum. This is objectionable in the highest degree. It is our duty to protest against rules which require so many hours in any single subject. That is simply putting a barrier against the development of higher education. The time has come to call a halt in these efforts at standardizing the curriculum, and attempting to require a fixed number of hours for entrance by the state board of examiners.

We at Johns Hopkins have never had to consider certain of the preliminaries which I know are urgent problems. The points that I wish to emphasize are these: It is necessary that every medical student should have a good liberal education, but it should not be taken up with reference to any utilitarian purpose. That can only be decided by the desire of the student. I judge it to be far better to secure an adjustment of what a satisfactory demand should be. Probably two years of preparatory work, telescoping the course of medicine with that of the arts and science degree would be desirable, but one should not make too rigid a statement as to precisely the requirements in physics, chemistry, and biology. These subjects should be studied themselves, and when studying chemistry it should be one with the object of learning the general principles. The student will then come to us with a better preparation than if he tries to get out of it those parts which will refer particularly to the study of medical courses. Any attempt to make such a preparatory course especially adapted to the study of medicine will be unsuccessful.

PRESENT POSITION OF MEDICAL EDUCATION, ITS DEVELOPMENT AND GREAT NEEDS FOR THE FUTURE[1]

President Dabney, Dean Holmes, Directors and Members of the University of Cincinnati, Ladies and Gentlemen.—This is the second inaugural ceremony which it has been my privilege to attend in connection with this university. It is now nearly ten years since I participated in the inauguration of President Dabney, when I had the honor to say a few words relating for the most part to medical education. It is a great pleasure to return and participate in this event. The inauguration of Dr. Dabney marked a new era in the growth of the University of Cincinnati, and now it is an especial pleasure to return to take part in this second inaugural ceremony.

This ceremony is not less full of promise. I feel that you are to be especially congratulated upon securing for the deanship of the medical department of the university the services of such a man as Dean Holmes. The man who today is assuming the duties and responsibilities of this position has a record of unusual attainment, knowledge and achievement. His has been a grand accomplishment in securing the establishment and erection of this wonderful city hospital, certainly the best city hospital in this country. In this connection, I may add that my colleague, Dr. Smith, superintendent of Johns Hopkins, says that he thinks it without its equal in the world. You are certainly to be congratulated on the taking up of this office by a man of such capacity of accomplishment, grasp of the problems involved, comprehension of the ideals of modern medical education, and striking knowledge and wisdom. I feel that he also is to be congratulated, and, in a certain sense, to be condoled by consequence of the difficulties he must face and which which he can conquer only by the hearty cooperation and support of the citizens of this city. But he is also to be congratulated upon the great opportunities for service which are presented to him. I take pleasure, therefore, in bringing the congratulations, not only of my colleagues of The Johns Hopkins University, but of the entire country, because the whole country has been greatly interested in the advancement of medical education. It must be a source of great pleasure to all friends of medical education that such opportunities are opening in this city, already honorably distinguished in that particular.

[1] Report of an address delivered at the Installation of Christian R. Holmes as Dean of the University of Cincinnati Medical College, Cincinnati, January 16, 1914.

Lancet-Clinic, Cincin., 1914, CXI, 104-110.

This occasion suggests that some expression be made concerning the relation of medical schools to the hospital. That question has been in the minds of previous speakers, and they have so largely said what I had in mind that I need to scarcely more than reinforce their words.

I do not propose to enter into a detailed historical statement in regard to the medical schools of this country; but I would like to call your attention to the fact that the initial period of the foundation of medical schools in America, toward the end of the eighteenth century, was characterized by nearly the same idea as that which prevails now. What the medical school should be, and what its relations should be to the university, was true of the foundation of the medical school in Philadelphia, now connected with the University of Pennsylvania. The same is true also of the college connected with King's College now Columbia of New York City, of Dartmouth, Harvard and Yale. They never dreamed in those days of the establishment of an independent medical school, but their chief aim was that the underlying conceptions should be sound. It was not until the second decade of the nineteenth century that independent, so-called proprietary, medical schools were established. It is true there were independent schools of this kind in Great Britain and Scotland, and it is possible that we have gleaned ideas from them; but the idea of an independent medical school not attached to the university with the right to confer a doctor's degree carrying with it a license to practise practically originated in this country. These independent schools were conducted on a quite rigid basis, but had scarcely any requirements for preliminary training. The courses were short, two years only, each repeating the other, a very faulty arrangement of the curriculum. The system was about as bad, in fact, as it could be. Nevertheless, it is possible to paint too dark a picture of that type of school, for the results were far better than the course would lead one to expect. It is not necessary to pass too harsh judgment upon them.

Dr. Holmes indicated some of the causes which have led to the great change in the character of medical schools in the last twenty-five or thirty years. But I shall add one or two important factors which I feel have contributed to this improvement in medical education. One of the important causes has been the great advancement in medicine. It became apparent that in order to teach modern medicine, the appliances of the early days, consisting of scarcely more than a lecture room and a small chemical laboratory, were insufficient to fill the requirements. In a word, the advancement and development of medicine in itself required an improvement in the methods of teaching medicine. Various factors have been at work and we are now in a transitional period. There are still great inequalities in the character of medical schools in this country. It is not, however, altogether

unfortunate that these inequalities exist. It would be a pity if there were entire uniformity and entire agreement in this particular. The independent and proprietary school with no equipment has been almost driven out of existence. It has been gradually supplanted by the newer idea that the medical school must be a part of the university. There is, of course, no saving grace in merely *calling* a school a department of the university. It must be an *incorporate* part of the university. This means that the idea of the university must be carried into the medical school. We believe now that the only type of school which can expect to receive support from the public must be a university medical school.

During the last twenty-five or thirty years, changes have been taking place in the character of our medical schools. There has been a great increase in the requirments for preliminary training. The difficulties in this matter are very considerable, and I understand they are to be discussed tomorrow in your conference. These difficulties are almost entirely due to the fact that our colleges have developed in this country without any heed to the needs of medical education, and it becomes, therefore, a matter amounting almost to an impossibility to link on the requirements for the professional curriculum. This subject remains for the most part an unsolved problem. Already there has been a great increase in the requirement for preliminary study. The most remarkable development has been in the improvement in laboratories. The weakest side of medical education was found in the laboratories, which in many instances, did not exist at all, unless one cares to call a dissecting room a laboratory. Nothing could be more remarkable than the development of laboratory work in connection with our medical schools during the last quarter of a century. Probably, in our stronger medical schools, that development has gone about as far as it can go, and it would be unreasonable to expect more time to be devoted to it than is now given.

The other great side, and really the most important side of medical teaching, namely, the clinical side, has not, in my judgment, developed to the same extent as the laboratory side. I do not mean to say, however, that there has not been great improvement in clinical teaching. There has been. But in pathology, bacteriology, biology and chemistry—I wish I might add hygiene—there has not been a corresponding development of the methods of clinical instruction, and the methods of laboratory training have made teaching of the so-called theoretical subjects a far more difficult task than the instruction in practical subjects. The laboratory method means that the student comes into intimate and continuous contact with the objects of study. He sees things with his own eyes, does things with his own hands, which furnishes the only vital knowledge that gives men power. Clinical

teaching to a very large extent, is demonstrative instruction. The amphitheater clinic and ward classes hold the same relation. Students are told how cultures are made, but in preparing them themselves, they are able to see the bacteria and to distinguish them. I do not decry such methods—they are most valuable—but they are not the most important methods in teaching. This development is to a certain extent significant and noteworthy for two reasons: First, our medical schools have, for the most part, no relation to hospitals so that they may use them for teaching; second, clinicians are not able or willing to give their main interest, time and thought to the teaching of their subjects in the same way as do laboratory men.

Why is it that our medical schools have not established satisfactory relations with our hospitals? It is because they have each developed independently of the other, and it is extremely difficult now to link the professional school to the college, and both to the hospital. It is always difficult for the medical school to secure the relationship to the hospital which is essential for the building up of great medical and surgical clinics. The most urgent need of medical education today, is the teaching hospital. A teaching hospital means something more than that the medical school is there on sufferance. It means being there by right. It means that the whole hospital shall be freely available for teaching purposes. It means, in short, that the professional staff of the hospital shall be controlled by the University Medical School. This means that the selection of physicians, surgeons, pharmacists, trained nurses, and all skilled operators and workers in the city hospital should be appointed, not by politicians, or even by a Board of Medical Advisors to a Director of Safety, but by the medical school authorities. Heretofore, hospitals have developed independently of medical schools. There is now an effort to bring them together. This is evidenced in the fact that recently over a million dollars was given to the Presbyterian Hospital, of New York, by Mr. Harkness, on condition that it become affiliated with the medical department of Columbia University.

Few medical schools in our country possess their own hospitals. I may say that the greatest asset we have at Johns Hopkins is our hospital. The most satisfactory cooperation exists between our hospital and our medical school. This relation is what made our hospital great. A few other schools are following this plan. I consider a most important change has been made in the establishment of medical teaching along better lines.

I am not pleading merely for medical education, for doctors, or for medical students, but for the welfare of patients and for the establishment of the hospital as a more useful institution. It has already been stated by Dr. Holmes that the best interests of the sick are attained when the hospital

is a high class teaching hospital. This is so true that I would not consider it necessary to repeat it if the audience were composed entirely of medical men. It is absolutely true that patients themselves are better studied and better treated in a hospital which is freely used for the purpose of medical education, than in a hospital entirely detached from medical teaching. This is so for many reasons. The kind of medical instruction which is most important is that which brings all students in their final years to the clinics of the hospital.

The amphitheater has its place, as does also the ward class. These are both demonstrative methods of teaching. The method that I would suggest might well be copied from the one used in Great Britain. The entire work of testing and analyzing done by paid employees in this country is done by the students there. This work is carried on with such great success by the British students, I am told, that it is difficult to secure equally satisfactory work during the vacation period of the schools. Students take greater pains and make more satisfactory and complete tests than do those employed outside of the college. This answers all questions that may arise in the mind of of the layman as to the liability of danger to the patient on being intrusted to the hands of a student. I wish to free the mind of the public also of the idea that the use of the hospital for teaching purposes carries with it any danger to the patient. It has only actual advantage to the patient. The teaching hospital is growing more and more in favor. It can secure superior talent for all positions. The very presence of students at the bedside and in the laboratories is a tremendous incentive to the physician in charge. It makes him more alive to the duty and responsibility resting upon him, both as teacher and physician. Dr. Keen expresses this very clearly in his book when he says that, surrounded by a lot of students, he feels as if he had a pack of hounds at his back. You can rest assured that the use of the hospital for teaching makes it a far more useful institution in the care and treatment of patients, as well as in determining the causes of diseases. If that were not so, I could not justify my plea, because the primary use of the hospital is for the welfare of the sick. The greatest hospitals of the world belong to this class of teaching hospitals.

There are three divisions into which the purposes of the hospital may be classed: Humanitarian, educational and scientific. The humanitarian relates to the care of the sick. The educational is very important, as we have seen, and the scientific relates to the advancement of knowledge. The great hospitals of the world belong to this class, in which these functions—humanitarian, educational and scientific—are clearly recognized. Without the college relation, your great hospital here will be, of course, of use and have some local reputation, but it will never be heard of outside of this com-

munity, if it is used simply as a humanitarian institution. If your hospital is to rank with the Vienna and Berlin General Hospitals, and it might well do so in all respects, you must recognize the fact that its functions are not limited to the mere care of the sick, but that it must also link the interests of education to the humanitarian functions. Those who are familiar with the methods employed in the German medical and surgical clinics know from actual experience that we have not a single real surgical clinic in this country. We have not even in Johns Hopkins anything more than a concentrated unit representing this work. The superintendent with us is supplied with a staff of men, who give their whole time to the work, and who are absorbed in teaching, in the care of patients, and in the advancement of scientific methods. These are the clinicians. But that work is not possible when combined with a large outside and absorbing practice. I want to plead for the so-called full-time professor. The heads of these clinics should be men whose main work is done in the hospital and the school. At the very outside limit, they should give half their time to this work in hospital and school. I have heard it said that we train just as good doctors and nurses in this country as they do abroad. I do not think it is necessary to gainsay it, but I do believe that we do advance the practice and art of medicine in our institutions as they do in Germany. These clinical teachers are the men who take up the problems and solve them. It is entirely wrong to draw any line between the theoretical side and the practical side of medicine. It is in the clinic of the type of which I have spoken that these problems are most likely to be undertaken and investigated.

I have attempted to indicate very briefly what I conceive to be some of the advantages of the teaching hospital, only possible through the union of the hospital and the university medical school. I have attempted to indicate to you that there are great advantages in such a hospital for the patient, the student and the physician, and that these relations also tend to the advancement of knowledge and the improvement of the art of medicine, and, since the hope of the race is in greater knowledge and the application of science, this discussion in view of the particular condition that exists in Cincinnati seems to me entirely justifiable. You have in many ways an unequaled opportunity to build up a great medical school. I think it is desirable that every medical school should consider that it may have some special opportunity before it. To illustrate: I was consulted some years ago by the Tulane University in New Orleans, and it seemed to me perfectly obvious at that time, that they could not do a more distinctive thing than to establish a school of tropical medicine when the Panama Canal was just about to be opened. They have since established a very good department of tropical medicine in connection with the medical school in New Orleans.

What is your great opportunity here in Cincinnati? It is the medical clinic, the teaching hospital. You have a hospital without any equal in this country in its possibilities for medical education. The Johns Hopkins is a much smaller institution than this. Here you have a large municipal institution. Ours is a corporate institution privately endowed and must always be limited. At Harvard they have no hospital in connection with their university. The latest addition there is a privately endowed hospital which is expected to be a real teaching hospital. In New York, the situation is extremely unsatisfactory. New York does not occupy the position of importance in medicine which a city of its size should occupy, because it has not the proper teaching hospital facilities. In fact, there is no place in this country with such an opportunity as you have. St. Louis has a fine hospital but relatively a loose relationship with it. The future of medical education is not going to lie with endowed hospitals. Their clinics can never be as large as yours. It will not be possible for them to provide for the care of hundreds of patients on account of the vast amount of money which would be required. One cannot finance any such proposition as that on a private basis in this country. But you have here a hospital equal in all essentials to the great one in Vienna. The opportunity is there on Burnet Avenue. The question of interest to me and to all medical teachers is, Whether or not Cincinnati will consider this opportunity, Whether or not this people will realize that the building there should be a great clinical hospital. Will you not make it, in the true sense of the word, a teaching hospital of the university? It must mean that the professional service of the hospital, either in whole or to such an extent as can be required, shall fall in the hands of the university, in order that this professional service shall be placed in the control of the medical department of the university. The men in charge should be young men, who are willing to give their time to it, young men who are trained and who will give continuous service in the hospital. If the relationship is satisfactory, you will, of course, need some endowment, in addition to that which has already been accepted. If this can be secured, you have the greatest opportunity of the moment in America. I heartily approve of the endowment of medical education. It is true that only in comparatively recent years has medical education been thought of as a worthy subject of endowment. But it is a fact, that medicine has advanced today to such an extent that it has a real power over the prevention and control of disease, and that it can do more in the relief of suffering and healing of disease by carrying out the plans I have indicated. When one considers the splendid gifts of Mr. Rockefeller to the Rockefeller Institute of New York, and the many gifts of money for medical research, including Mr. Harkness' recent gift of over a million dollars, it is perfectly plain that people are more widely awake

to these needs than we had anticipated. Unfortunately, there is not the same interest in giving money for professional medical education as for other purposes. That is a subject more or less by itself. But I think the argument is just as strong for the endowment of medical education. In the first place, it is a great mistake to suppose that medical research can be supported without any consideration for medical education. One will most certainly advance medical research by improving medical education. The real hope is with the university where the studies in fundamental sciences are carried on. In the university is the atmosphere which should be most favorable for all scientific study. There we have a certain contact with the students, and certain stimulation of interest in work which I believe, as a rule, to be a direct advantage. The best medical teachers are investigators. They have the power of making an impression which others do not. The man who is a contributor to knowledge always has something by way of stimulation and inspiration which the other teacher has not. In other words, a strong plea can be made for medical education in a university like yours. You have here in Cincinnati in this medical school a splendid opportunity. It would make one of the most interesting chapters in the medical history of America and of this city, as Dr. Osler has said in his telegram, referred to by Dean Holmes, to honor the name of Daniel Drake, a man whose name occupies a place in the history of the world, by associating it with the foundation of a medical school here in Ohio; for as you know, he was a great student of the diseases of the Ohio Valley. Nothing else could be more appropriate than such perpetuation of the name of this great medical hero.

I see by this program that there is to be a presentation of a portrait of a very dear friend and classmate of mine, Dr. Forchheimer, whose memory I cherish with love and affection, and I find that you propose to establish a chair also to perpetuate his name. I hope it will be done.

My one purpose has been to indicate to some extent the present position of medical education, its development, and its great needs for the future. The most pressing need today is the one which you have the opportunity to fill to a fuller extent than any other city in the country. If you will realize the situation, and grasp the opportunity, and get the ways and means to meet it, you will do the best thing that can be done for medical science in this country. You have here an opportunity to establish a medical department in the University of Cincinnati which will also perpetuate the history of the two schools of medicine, the College of Ohio and the Miami College, each one extremely interesting. You already have strong men on the teaching staff of the school. It seems, therefore, as if the step forward was so obvious, so easy, that, if there were only an appreciation of what it would signify for this community and for humanity, we could all look forward with certainty to great developments here.

THE HARVEY LECTURE

MEDICAL EDUCATION IN THE UNITED STATES[1]

I assure you that it is a great delight to me to have this opportunity—and I seize everyone that presents itself—of returning to my old home. I treasure the associations of those days when I was a part of the profession of New York, and it has been a delight to me to continue in contact with things medical and with my friends and colleagues of this city. I esteem it a high honor to be asked to give one of these lectures. I must pay tribute to the conception underlying the establishment of the Harvey Society. When one considers the purpose of these lectures, the opportunities which they offer, and the influence which they exert, it is an honor for anyone to be asked to be a Harvey Lecturer.

The purpose of the lectures is to present the results of original research. I am rather glad that Dr. Wallace relieved me of the responsibility of having to choose the subject I am to speak on. It would not have been one of my own choice and I question whether it is altogether suitable for this course of lectures. Nevertheless, it is not altogether undesirable that a lecture on medical education should come under this foundation, because everything that concerns research and the conditions favorable for it are dependent upon education, and surely the roots of scientific research lie in the educational system of the country. I think it is more clear than ever in these days, with the establishment of separate research institutions and the interests attaching to scientific investigation in general, that, after all, without a satisfactory foundation on the educational side, research cannot flourish.

It is enough, I think, to point out that such an independent, fruitful research institution as the Rockefeller Institute doubtless could not have justified its establishment twenty-five years ago. That is because improvements in medical education had to precede the foundation of such an institution, and I venture to say that themes which relate to all conditions which affect the development of laboratories, all the material conditions so little understood in general which figure in the development of research, are not out of place in a course of lectures where the prime purpose is to present the results of research.

I am somewhat at a loss as to how to treat the subject of Medical Education in the United States which has been suggested to me. It is obvious that it is

[1] Report of an address delivered before the Harvey Society, New York City, April 20, 1916.

Harvey Lect., Phila. & Lond., 1915-1916, 366-382.

impossible to cover the whole subject and I must ask your indulgence for selecting certain aspects of it, not altogether connected, but such as seem to me to be of primary, or, at least, of special interest.

Nothing is more remarkable in medical conditions in this country than the progress of the last half century in the development of medical education and of medical science, and especially during the latter half of that period. This progress came first in medical education, and as I have already indicated, I think it was a necessary condition for the subsequent development of investigation in medicine. The progress is remarkable when one contrasts it with conditions which had existed before; more remarkable when one contemplates how very far short we still fall of the ideal. We cannot contemplate with any great satisfaction the early history of medical education in America. Probably medical education had nowhere, at any time, fallen to such a low estate as it did during a large part of the last century in our country. The early traditions, which came from Scotland, were sound. They recognized that a medical school should be a part of a university and they also recognized the essential relationship of such a school to a hospital. But with the rapid development of the country and largely as a consequence of that rapid development, new ideas, essentially novel, unheard of before or since, developed as to the organization of our medical schools. I refer to the establishment of independent medical schools without connection with universities, without vital connection with hospitals, with the power to grant the doctor's degree, and that degree carrying with it the license to practise.

We are so familiar with the existing system in this country that we hardly realize that there has been a distinctive problem in America, the fundamental evil resulting, of course, from the divorce of the medical school from the university and from the hospital, in that each followed its own line of development, with little or no heed to the other. Our problems today are, to a very large extent, the result of that condition. They consist in the first place in an effort to establish a relationship which should have existed at the beginning between the medical school on the one hand and the university and the hospital on the other. And it is not a little remarkable that on the whole it is much easier to establish the desired relationship with the university than it is with the hospital.

Now I do not wish to be too harsh in judgment of the old order of things in medical education in this country. The system was about as bad as it could be, but there were compensations, and these were undoubtedly due to the character and caliber of the teachers in many instances. Even the characteristic medical schools that are of historic interest in the frontier of America, had a very remarkable group of teachers and professors—such

men as Nathan Smith, Daniel Drake, McDowell, Dudley. Mere mention of these names to one who knows about the history of medicine in this country is enough to indicate that any young man who came under the influence of such teachers as these must have derived great profit. In other words, the results were better than the system.

I received my own education here in New York before any marked change had taken place in these conditions, but I entertain and cherish a great feeling of gratitude to many of my teachers. I received stimulus from men like Dalton and Delafield, and later from Dr. Jacobi, my attending physician at Bellevue Hospital, and the elder Janeway. Mere mention of these names rouses enthusiasm and interest. We were brought into contact with high ideals of the profession, notwithstanding all the defects in the system of medical education.

Now a change has taken place and, as I have indicated, a change so great as to mean a definite break from the old order, and it is worth while inquiring concerning some of the factors which are concerned in this improvement. Their enumeration will enable me to make a few comments of a somewhat general nature.

There has been, for half a century or more, an awakening of professional opinion on the subject, which, however, has had surprisingly little effect on medical schools. If one were to enter into an historical review, it would be necessary to go back as far as 1859 when the Medical Department of Northwestern University established a graded course. Later on, at Harvard and at the University of Michigan, improvements came in as regards standards, methods, and certain requirements for admission. But I trust that it will not be deemed immodest if I suggest some of the contributions which the establishment of The Johns Hopkins Medical School in 1893 made to medical education. It had no monopoly of contribution to progress in this direction, but there were certain conditions which enabled us to make rather distinctive advances. In the first place, we were fortunately situated, as things were at that time, on the material side. There existed The Johns Hopkins Hospital and the University, and an endowment, which, although not large, was larger than any existing at that time in this country for the promotion of medical education. There was furthermore the standard set by the university in the promotion of a higher university education, as distinguished from college education, so that we realized that we had an opportunity. We felt that it was not worth while to start a new medical school unless we could make an addition to the methods of medical education.

When the school was started it had certain preliminary requirements for admission, which still exist, which were not altogether of our own free choice because they were a part of the conditions of the endowment which enabled

us to begin. I do not propose to discuss in detail the subject of the preliminary education for the study of medicine, but I would point out that the particular requirements which were introduced at that time represented an effort to adjust medical education to the existing, rather anomalous condition of general higher education in this country. We require, as you know, a liberal education as represented by a degree in arts and science. Recognizing that the college keeps the students longer than it should for entrance upon professional studies, we ask them to supply training in the sciences fundamental to medicine, chemistry, physics, general biology, with a reading knowledge of French or German. These subjects—chemistry, physics, biology—in the curriculum of European universities come under the medical studies, so that a comparison with these foreign medical schools represents at least a five-year period of study. We ask the college, then, to supply two or three subjects which abroad are included in the medical curriculum.

We did not think at the time, nor do we think now, that our standards are those likely to be generally adopted in this country. We have never urged it. It has worked well with us and we are not inclined to make a change. It is an effort at adjustment to existing conditions of higher education. All other efforts to adapt medical education to secondary and collegiate education in America encounter many difficulties. A high school education is not sufficient, unless our high schools develop into something more comparable to the German gymnasium or the French lyceum, as there is some tendency to do in the West. There results an attempt to find a place to stop between the high school and graduation from college. The tendency is to require two years of college work; to bisect transversely, if you will, the college course, and very often associated with that is the telescoping of the last two years of the college course into the professional school, so that two years of professional study are counted both for the bachelor's degree and for the doctor's—obviously a makeshift arrangement. The result of this development of the medical school and college or university apart from each other forms a condition which would never have existed if it had not been for the anomalous development on each side. I feel that a liberal education is highly desirable for students of medicine. With this should go training in the power of observation and in the capacity to interpret what one sees, in a word the power to use the senses.

Those of us who are interested in medical education must be very much alive to the possible improvements in secondary education. It is to be hoped that the time will come when the young man may complete his secondary education, have added to that the college education and be enabled to enter upon his medical studies when he is 19 or 20 years of age. This will

be solved, I believe, rather by an improvement in secondary education than in any other way.

Such, in brief, were our requirements for admission, which still hold, to the medical school. I think we can also point to the organization of the laboratory, or so-called preclinical subjects, on a more adequate scale than previously existed in this country as a contributing factor in the progress of medical education. The anatomical laboratory, of course, had existed for centuries, from the time of Vesalius, and by virtue of the fact that anatomy was the only subject with which the medical student gained any sort of direct, personal contact with his subject, it had great educational value. It still remains, of course, a fundamental subject, but it has acquired undue prominence in the medical curriculum by virtue of the fact that it was the only subject which was pursued by laboratory methods until recent times. The physiological laboratory is traced, in this country, mainly to the work of Bowditch in Boston and Newell Martin at Johns Hopkins, but it cannot be said, I think, that physiology had taken the place which it should hold in medical education much before a quarter of a century ago. One of the great marks of progress in medical education is due to the recognition of the fundamental nature of physiological study for the training of the physician, so that knowledge of the activities of the normal body is, to say the least, just as important as a study of the structures of the normal body, and it is a rather distinctive contribution for American medical schools to have established good laboratory courses for medical students. I see in the audience Dr. Porter of the Harvard School who has had such an influence and done so much in advancing these courses. It is still difficult to arrange an entirely satisfactory routine course for undergraduate students in the physiological laboratory, but I believe that we do more in that direction than is done abroad.

The other subjects which we succeeded in establishing upon a fairly adequate basis were pathology, bacteriology, pharmacology and physiological chemistry, and perhaps in the first instance, because this great group of preclinical subjects, designated now as laboratory subjects or medical sciences (as if the clinical subjects were not also scientific!), for the first time were adequately organized with laboratories, with a group of teachers as heads of laboratories, with their staff devoting their entire time to the work and with an emphasis upon the practical and laboratory training as contrasted with didactic lectures or mere demonstrations of the subjects.

These first two years of the medical course were founded upon certain principles. In the selection of the teachers, they were sought wherever the best available ones could be found and emphasis was laid in that selection, upon the productive capacity of the men. That qualification of the teacher,

the productive capacity, is, in a medical school, the important thing and headships were given to men who had earned them by their contributions, and in general their published contributions to their subjects. This guided us at that time.

As regards the clinical side, we at the beginning made slower progress. To Osler, especially, we owe the plan which was adopted. The main thing perhaps was the introduction of the English plan of teaching the fourth year students in the wards of the hospital by the system known as "clinical clerks," a marked advance, I believe, in clinical teaching. The creation of the clinical laboratories was also a great advance. The change from the old order was not so striking on the clinical side as on the laboratory side. At once, you might say, the laboratory side of medical education passed from being the weakest, almost nonexistent side, to the strongest side of the medical curriculum.

The plan of the organization of the hospital was, I think, a considerable improvement. It consisted mainly in the introduction of a higher resident staff over the internes, so-called house officers; that is, there were resident physicians, surgeons, gynaecologists, obstetricians, over the interne. I have often wondered that this system has not been more widely adopted in this country. It offers a very great advantage. It affords opportunities for the prolonged advanced training of the young men and also the young women who are so fortunate to obtain these positions. The positions are for an indefinite period. The young men devote their entire time, of course, to hospital work and are expected to undertake some investigative work. If you recall the names of those who have held these positions as resident physicians and surgeons, I think you will appreciate that by the time they have left they have often established their reputation by their contributions, and that the value of that system of organization of the professional staff of the hospital is very clear.

More recently we have come to hope that we shall be able to initiate a very great reform on the clinical side, in the placing of the clinical portion on the university basis by which the heads of the departments may give their entire time to the work. I shall touch on this point later.

These various points, then, I think, marked and set an example in the direction of a very considerable improvement in the medical educational system. I do not desire to claim any monopoly on the part of The Johns Hopkins University for these advances, because other universities have contributed largely, such as the University of Michigan, but we happened to be first in the field in many of these directions, and I think the plan adopted by Johns Hopkins is one factor and the earliest one which has led to recent improvement of medical education in this country.

The creation of state licensing boards has had great influence in exerting pressure on the inferior medical schools, crowding them to the wall and very often driving them out of existence. The principle, of course, is correct that the license to practise should not go with the granting of the degree of Doctor of Medicine, especially when one considers the system and the conditions under which the degree is granted. The influence of these state licensing boards has thus been very great in bringing up the general average of medical schools. They have been of no particular assistance and some time ago almost threatened to be a handicap to the better medical schools. Of course we all recognize what such examinations should be. The character of these examinations falls very far short of the ideal, especially in the lack—although there is an improvement with time—but in general, in the lack of a practical examination, so that it does not furnish any real test of power of the student to use the implements of his profession or of his real living knowledge of the subject. They will improve doubtless, and it is to be expected that in time conditions will be such that those on the examining boards will be also teachers in our schools who are the ones most competent to examine.

The Council on Medical Education of the American Medical Association and the Association of American Medical Colleges entered the field later and have done a great deal in improving conditions, especially in leading professional opinion on the subject and inciting to a very considerable degree a moral pressure. There have been at times, I am frank to say, certain tendencies in the Council on Medical Education to make one pause, such as the efforts to "standardize the curriculum," fortunately halted before serious damage was done. I think it objectionable to attempt to indicate the number of hours, for example, to be devoted to the study of a subject, and at one time our state licensing boards seemed inclined to introduce some such scheme. Of course we want as elastic a condition as possible. When one considers the importance of adjusting medical education to the changes and advancing conditions of medical knowledge, how absurd is the attempt to specify the number of hours to be given to any subject, bacteriology for example! Only a few years ago the subjects of immunology and serology were not thought of as belonging in the medical curriculum, but today things have changed and they should be an important part of medical training. We owe our great working policy in medical education to the conferences held annually in Chicago, attended by leading educators, not only in medicine but other subjects as well. Such conferences are very valuable and the publications very interesting and often important.

Another great factor is Dr. Abraham Flexner's report for the Carnegie Foundation. I consider it to be one of the most remarkable and influential

publications in educational literature. It has had not only a large influence upon professional opinion, but especially a large influence on universities and upon public opinion.

But of course the progress of medicine itself lies back of it all. The face of medicine has changed greatly in the last thirty or forty years, although it is the same medicine in many ways. That medical education should continue without advance during all the great discoveries characteristic of this era, would hardly be conceivable.

I have run briefly over the history of some of these factors bringing about improvement in medical education, because I wish to make some comments of a more general character. I have already spoken of the development of the laboratory subjects. It is worth repeating, perhaps, that it was a consequence of the organization of the laboratories of anatomy, physiology, pharmacology, bacteriology, etc., and the selection of men devoting their entire time to the work, selected on the basis of scientific ability, that these great sciences have progressed to the point which they have in this country and of which we are so proud. To give an instance of the close relationship between the progress of medical sciences on the one hand, and of our educational system on the other, it was only two or three years after our medical school had opened that we started the "Journal of Experimental Medicine." It was the pioneer journal devoted to the publication of papers of a more or less technical monographic character in these sciences. I recall so well the doubt expressed at the time as to whether there existed enough material of the sort which was desired to keep the journal alive. We never dreamed of limiting it to any one of these so-called laboratory subjects. We endeavored to select a title which excluded merely practical, clinical medicine, and was not restricted to any one line of research. I cite all this as an example of conditions which existed only a short time ago. It was within two or three years that Dr. Porter found the time had come to establish a "Journal of Physiology," which was the first offshoot from the "Journal of Experimental Medicine," and then came in rapid succession, the "Journal of Anatomy," "Journal of Biological Chemistry," "Journal of Medical Research," "Journal of Infectious Diseases," "Journal of Pharmacology and Therapeutics," and still more recently the "Journal of Bacteriology" and the "Journal of Immunology." Is it not wonderful that in such a comparatively short space of time these subjects should have developed in this country to the height of which we are now so proud as exemplified in the contributions appearing in these journals?

America today, as a contributor to the various sciences of medicine, stands in a position more nearly commensurate with the size and importance of the country. We lay, I believe, probably greater emphasis upon the teaching of

undergraduate medical students in the laboratory than is done elsewhere; we devote more time to the teaching of undergraduate medical subjects by laboratory courses in certain subjects particularly—I have already cited them—than is done abroad. There are already developed certain distinctive characteristics of our American medical schools and this is one of them. Of course it makes us inquire whether we are possibly giving undue prominence to some subjects, but I would be the last one to admit that, although at the same time we should bear in mind certain things. We cannot teach in the laboratory more than a very small fraction of the contents of the subject; only a part of it, and that not necessarily the most significant and important. In other words, is there not some risk of acquiring too restricted and limited a conception? Is there not some risk of a loss of perspective in the subject by exclusive emphasis upon teaching in the laboratory? I believe so firmly in the laboratory method in imparting that kind of knowledge which is really vital, a knowledge that gives power, that I do not wish to be misunderstood and be thought to minimize its value, but I think we must supplement the laboratory teaching by efforts to secure these broader conceptions and this clearer perspective. I have never been willing to give up altogether the lecture. If one does not believe in lecturing, I think he had better not lecture. I think there is some value in a lecture, and I think proper emphasis in lectures and recitations will enable teachers to stimulate the student and exert some pressure to make him read. The students do not read enough. As a rule, they know only the subjects which are taught in the laboratory. I will not labor the point, but I would emphasize the fact that we should consider it very carefully.

I turn now from the laboratory side of medical education to the clinical side. That, of course, is the central feature. The teaching of the clinical subjects should be carried out along the same general lines as those of the laboratory. At the start there were efforts in this direction, especially in the use of students in the wards of the hospital, acting as clinical clerks and surgical dressers.

When one considers what should be the functions of the head of a principal department of medicine, when one considers that he is responsible for the teaching, responsible for stimulating investigation and for having the right sort of men for the conduct of investigation in his field, responsible for the study and care of the patients in the hospital, and the whole organization of the department, it seems to me that it requires no argument that whoever assumes that responsible position as head of a clinical department should be prepared to devote his entire time to it. There is no time to engage in an outside practice. I know that it is urged that the clinical teacher who limits his experience to patients in the hospital is deprived of a very valuable

experience to be derived from outside practice. It is a valuable experience undoubtedly. I think it would be still more valuable if he had a rural and family practice. I doubt if anything in the ordinary conditions of a consulting practice in the city is as likely to develop resourcefulness in a physician as a rural practice. In a word, of course, the more varied the experience of the clinician may be, the more must he be brought in contact with patients and unusual conditions, but there are limits to human endurance, time and energy, and the question is, What is the best use of his time? Can we doubt whether it can be successfully maintained that the expenditure of time in seeing patients in consulting practice is as valuable to him as the study of cases of disease in the hospital under all of the opportunities which exist there? The time has gone by when a man can do both competently and with justice to his position as the head of an important clinical department in the medical school.

How this condition is to be brought about is, of course, very important. We have endeavored at Johns Hopkins to do this by making no compromises. Through a generous endowment from the General Education Board, we have been enabled to place three of our main clinical departments, those of medicine, surgery and pediatrics, upon the so-called "university basis" or, as more commonly called, the "full-time" system. I do not particularly like the latter name; for teachers under this system are the only ones who have any leisure time.

Of course the heads of the departments should not be prohibited under the new arrangement from seeing private patients, but they are paid such salaries through this endowment that there is no necessity for them to earn a livelihood through private practice. They can see private patients if they like, but not having any financial interest in seeing them, they will see only those that are of special interest to them. Now, our experience thus far shows that the amount of this private practice is kept within pretty narrow limits by the withdrawal of financial inducements. The patient, of course, pays a fee, but the fee goes to the fund for the promotion of the system. This is a detail and not an essential part of the system, and other solutions are possible. I do not see very well how one could justify the raising of a large sum to pay clinical heads on the university basis if they should be allowed to supplement their income from private practice. This would be a great injustice to the laboratory men. The salaries which they receive are much larger than those received by laboratory men. I agree that university professors who are of the caliber of the men occupying these positions ought to receive similar salaries, but as a matter of fact, I think you can justify a somewhat larger salary to the heads of clinical departments on the ground that they are serving the hospital as well as the university; that

they have very responsible duties in the care of the patients and that after all a clinical department, with its staff and hospital branches of clinical and investigatory laboratories, is a larger undertaking than a single laboratory, so that one can defend the paying of larger salaries. But it is sufficient, I think, to say that the opportunity has been presented to us and we have been glad to initiate this system and to pay these salaries. How widely the system as we have adopted it should be generally applied, I am unable to say. It has no saving virtue in itself; it is the men who operate it who are fully responsible for its failure or success. To introduce it where conditions are not suitable, where the hospital does not afford the requisite patients and laboratory facilities, and the staff of full-time young men, would be useless. It is only where conditions are suitable that the system should be adopted, but when it is carried out in the uncompromising way that we have done, it undoubtedly marks, I think, one of the greatest improvements in medical education of recent times, and is bound to exert a very great influence on the character of the organization of the clinical departments of the medical school. We have had it for two years and we like it. I think it has passed the experimental stage as far as we are concerned. I do not wish to say that there is not room for further improvements, but we have had the opportunity to make a very great improvement and we were glad to seize that opportunity. The plan does not necessarily do away with the services of part-time men in the school. He finds a place in the school, only he is no longer the head of the department. I take it that the new system creates new careers and opportunities for young men. The very fact that what seems to so many a serious objection, viz., the difficulty of filling positions with men who are qualified for this kind of work is in itself a criticism of the existing old system. But I do not know what could be better than to enter into such an opportunity as is now offered, devoting one's time to the study of problems of disease as they are presented by the living patient to work in the laboratory and to study at the bedside.

As regards the establishment of the proper relations of the hospital to the medical school, there is much that can be said, but the time has gone by when it is necessary any longer to emphasize the great service which the hospital devoted to education and scientific work, as well as to the humane care of the patients, renders for the community. But it is necessary to dwell on the character of organization of the university clinic, as distinguished from the general hospital. Those who are familiar with medical education abroad, especially in Germany, know that sometimes part of the hospital is the clinic, the rest a general hospital. In other words, the mere saying on the part of the trustees that you can use the hospital, is not enough. It is a very considerable undertaking to transform it in whole or in part into a general university

clinic, meaning by that that there is one professor in charge with a staff of assistants or associates, with a chemical and biological laboratory available for the study and investigation of problems of disease, and with all the necessary arrangements for teaching, for the treatment of patients, the whole grouped as a single department. That is, in a word, what I conceive to be the proper organization of the true university clinic.

I have jotted down a great many other topics for consideration, for which no time remains. Certain of these are of especial interest to me. I would like to say something on the general subject of research and teaching and also on the relationship of the independent research institution to educational institutions in general. There is a little apprehension, particularly on the part of the universities that independent research institutions, like the Carnegie Institution of Washington and the Rockefeller Institute, are drawing able investigators from educational institutions. I think, on the other hand, that these research institutions have abundantly justified their existence by their contributions to science. That is, indeed, quite obvious. But I think as time goes on that they will supplement the educational institutions. Anything that increases the opportunities and rewards for the scientific worker is undoubtedly of very great advantage. One reason why Germany has obtained such a high stage in scientific investigation has been because the career of the scientific man was made attractive. By rewards I do not mean so much the pecuniary ones as the satisfaction which comes from contributions, the esteem in which the worker is held by the community. These careers are rendered more attractive by the establishment of these institutions. It is true, of course, that some of the very best trained men are withdrawn from the educational field by their work in the research institutions, but it is of very great advantage to the teaching institution to know that such positions are available for students. It increases their value, I think, in that way very much. It acts as a stimulus on the educational institution to further research. As time goes on they will begin to return to the educational institutions men who have had this very superior training in research. I believe, on the whole, that over-multiplication of separate research institutes would be undesirable. The future relation between the independent research institution and the educational institution will be increasingly advantageous and each is going to be of great help in the end to the other.

I must omit a great many topics, which I should have liked to have touched upon. I wanted to say something about the medical curriculum, optional courses, and many other things.

I do not wish to leave the impression that there are no great deficiencies in our own medical school. I have enlarged upon the progress which has been made more in contrast with the past than from a feeling that we have

begun to approach the goal. It would be interesting to point out and to dwell upon some of the deficiencies but time allows an enumeration of just a few.

We are lacking in the proper cultivation of legal medicine, a very important subject and one of importance to the clinician. Of course we all recognize that one of the great needs of medical education is the establishment of institutions or schools of hygiene. I would like to have said a few words about the teaching of the history of medicine in our medical schools. It adds greatly to the attractiveness of medical study and I believe also to the enjoyment of the physician later in his professional work to find how knowledge came to be. I do not advocate systematic lectures on this subject. I do not know of anything likely to be more dull and uninteresting to the average student, but there are other ways of cultivating this subject.

Are we training men to serve the community in the treatment of disease any better than they did in the old days? From the beginning the aim in training has been to enable the physician to prevent and to cure disease and injury, to relieve suffering, and to preserve health. These aims are the same today as they have always been. It is this consistency of purpose which gives the wonderful interest and continuity to the study of the history of medicine. Notwithstanding all of the wanderings of the past, we are striving for the same aim as before. There have been opened new fields, new vitas, new methods, new powers over disease, so that what was suitable for training to meet these great aims in the past is no longer the best. The fundamental thing, the fundamental problem in medical education, is to train men to use the resources of the medical science and art most efficiently for the prevention and cure of disease and I believe that while many of the commonest ailments of mankind are no better treated today than in former days, it is also true that we have come into possession of life-saving new knowledge. To make available for the relief and cure of human diseases and injuries all the resources of modern medical knowledge and skill is a problem of the utmost importance to the welfare of human society. The part which medical education has to play in securing this great end is fundamental and important and should guide all efforts in the advancement of this education.

THE RELATION OF THE HOSPITAL TO MEDICAL EDUCATION AND RESEARCH[1]

The most urgent need of the medical schools of this country at the present time is the possession of well organized and well equipped hospitals, available for teaching, and I esteem it a great privilege to bring greetings and congratulations to the Jefferson Medical College on this splendid addition to its educational resources. Coming, as so many of us do, directly from the meeting of the American Medical Association in Atlantic City, my colleagues, representing the medical profession of this country, will surely be glad to have me express on this happy occasion in their behalf congratulations to this college and to this city. We must all rejoice in the enlarged opportunities for bedside teaching supplied by this fine hospital to the Jefferson Medical College, which from its foundation over eighty years ago has laid especial emphasis on clinical instruction, which has sent forth so many graduates who have achieved professional success and eminence, and which has possessed such distinguished teachers and ornaments of our profession as McClellan, Eberle, Dunglison, Bache, Drake, Meigs, J. K. Mitchell, Dickson, Pancoast, Mütter, the Grosses, Brinton, Da Costa, whose worthy, living successors will not deem it invidious if I add to this incomplete list the name of that leader of American surgery, their absent colleague, Keen, who, resting from his many years of brilliant and successful work in behalf of this college, will in a distant land be glad with us today.

The Jefferson Medical College is indeed singularly fortunate in the possession of this large general hospital, admirable in construction and arrangement, entirely under the administration of a single board of trustees common to the college and the hospital, who control all of the appointments to the hospital staff and who in serving the best interests of the patients are in the fullest sympathy with the needs of medical education and active in its promotion. It is precisely the lack of hospitals under the control of our medical schools which constitutes one of the most serious obstacles in the development of medical education in this country, and all interested in the advancement of medical science and teaching in America have reason to be grateful to the State of Pennsylvania and the private benefactors whose

[1] An address delivered at the Opening of the New Jefferson Medical College Hospital, Philadelphia, June 7, 1907.

J. Am. M. Ass., Chicago, 1907, XLIX, 531-535.

enlightened generosity has made possible this enviable possession of the Jefferson Medical College.

The theme of my remarks on this occasion—the relation of the hospital to medical education and medical research—is naturally suggested by the event which we are assembled to celebrate.

The discussion of the problems of clinical teaching and investigation by one engaged in laboratory work, although actively interested in all that pertains to the advancement of medical education, may have the advantage, so useful to a speaker, of a certain detachment of view, of length, if not clearness, of perspective, and of the absence of too disturbing a consciousness of all the difficulties inherent in the working out of details.

It would be interesting to trace the evolution of methods of clinical instruction from their inception, or rather revival, in Padua by Montanus about the middle of the sixteenth century to the present time. We should follow the conveyance of these methods by the elder van Heurne toward the end of the sixteenth century from Padua to Leyden, where in the course of a century they reached the high development attained under the great Boerhaave, *communis Europae preceptor,* and whence influences, spreading in the eighteenth century first to Göttingen, Halle, Vienna, and Edinburgh, can be traced continuously down to this very day and to the medical schools of America. But such an historical survey, hitherto imperfectly drawn, is a theme by itself, which I must forego, although commending it as an attractive one to medical historians.

While the early history of medical education in this country is a story of feeble resources, but still of high endeavor and of just appreciation of the requirements of training for a learned profession, we cannot contemplate with similar satisfaction and pride the deplorable period which followed through many years of lowered standards of preliminary education, of shortened courses, and of faulty arrangement of the curriculum. Nevertheless, these unfortunate conditions, attributable mainly to the circumstances of rapid pioneer development of the country and to the absence of any responsible supervision outside of the medical schools, were saved from giving results as bad as they are often depicted and as the system seemed to demand by a measure of practical, clinical instruction, by the high character and gifts of many of the teachers, and by the preservation of sound traditions of the physician's calling.

Nothing is more remarkable in the history of medical education in this country than the rapidity with which our better schools have emerged in the last two decades from this low state. Especially noteworthy during this period is the development in these schools of laboratory teaching from the weakest to the strongest position in the curriculum, with the corresponding

and most gratifying growth in this country of the sciences of anatomy, physiology, pathology, biological chemistry, pharmacology and bacteriology. Hygiene, unfortunately, has lagged behind, mainly, I believe, through lack of careers for trained hygienists in this country, especially on our boards of health.

The introduction and development of laboratory teaching has had a profound influence on our ideas of methods of medical education. In the laboratory knowledge is acquired not by reading or being told about things or even by seeing them demonstrated by another, but by immediate contact with the object of study, by power to use technical instruments and procedures, and by personal observation and experiment. A final adjustment has not yet been reached between this practical method of acquiring knowledge and the older didactic or expository method, to which within proper restraints I am not unfriendly, but the days of dominance of didactic teaching in our medical schools are numbered.

A pertinent inquiry in this connection is, Whether improvement in the teaching of medicine and surgery has kept pace with that of the laboratory subjects. Improvement in the former there has been, but it is, nevertheless, true that the so-called theoretical subjects are today taught most practically and the so-called practical branches most theoretically. It is above all familiarity with the methods and results of teaching in the laboratory which has emphasized this contrast and has indicated directions of improvement. Such contrasts, however, as those implied in the distinctions so commonly drawn between theoretical or scientific subjects on the one hand and practical subjects on the other in the medical curriculum, and between the methods of teaching in the laboratory and those of teaching in the hospital are unfortunate and not inherent in the nature of the subjects. Both classes of subjects are practical in that they admit of application to practical use and in that their common aim is to serve the training of practitioners, and both are scientific in that they rest on and are furthered by coordinated knowledge gained by systematic observation, experiment and reasoning. The justification for the presence of any obligatory subject in the medical curriculum and for the amount of time devoted to it is its importance for the training of sound practitioners of medicine and surgery. Nor should there be any difference in the general principles underlying the methods of teaching the laboratory subjects and those of teaching the clinical branches. For the latter the hospital is the laboratory where the results of nature's experiments are to be studied and alleviated by the methods of science.

Training in the laboratories in the early years of the medical course should be a preparation for the final work in the hospital where the ultimate goal of medical education is approached—the ability to interpret and to fore-

cast, and the power to prevent, to remove or to relieve the manifestations of disease and injury. Important as clinical teaching must have been even in the relatively undeveloped state of medicine and surgery in past centuries, it is vastly more important in these days of accumulated medical knowledge and experience, of refined methods of diagnosis by physical examination and by a multitude of technical procedures, and of improved methods of medical and surgical treatment.

Do the methods of teaching the clinical subjects generally adopted in our medical schools at the present time bring the student sufficiently in that intimate, prolonged, personal contact with the object of study, in this case the living patient, which secures that abiding, vital useful knowledge, the possession of which alone is power for good, and the lack of which is helplessness and even power for harm? As I have intimated, I believe that the clinic falls behind the laboratory in this regard, and that the greatest strength of the curriculum is not where it should lie.

It is not many years since practically the sole method of clinical teaching in the medical schools of this country was the amphitheater clinic. Not a word need be said against the value of this important form of clinical instruction, but no argument is needed to show that by itself it does not suffice for the practical training of students in the science and art of medicine.

A distinct advance was marked by the introduction in recent years of the system of ward classes, by which students in groups are admitted to the hospital wards and given opportunities to examine patients and to receive personal instruction. It is not necessary for my present purpose to discuss the various forms of these ward classes or the methods of conducting them, or similar classes for practical, clinical instruction, or to point out in detail their great value to the student, which is universally recognized.

Neither the amphitheater clinic nor the ward class meeting under an instructor at stated hours and for short periods of time, useful as they are, represents the full ideal of the laboratory method of teaching. They correspond rather to demonstrative courses, which have their own place and value. Such courses alone would represent the attempt to teach a subject like bacteriology by demonstrations of methods, cultures and microscopic slides instead of having the student make his own media, plant and cultivate the bacteria by his own hands, and follow and study from day to day with his own eyes the characters of the growing organisms. It is only by the latter method that bacteriologists are made and it is only by a similar method that capable practitioners of medicine and surgery can be made, and if this essential training is not at least begun in the undergraduate days in the

medical school, it must be secured, if at all, later, often under disadvantageous circumstances and at great cost both to patient and to physician.

This kind of clinical training means practical work in the dispensary and especially that students in their final year of study have patients assigned to them in the public wards of the hospital, where under proper restrictions they can freely come and go, that they take histories, make necessary examinations for diagnosis, follow the course of disease from day to day and become familiar with methods and results of treatment, all of this work being, of course, under competent supervision and undertaken only after suitable preliminary studies. Privileges and opportunities for practical training of the kind indicated are at present enjoyed in most of our hospitals only by the fortunate internes, but the system is familiar in Great Britain as that of clinical clerks and surgical dressers, and in Germany as that of *Praktikanten,* hospital service in this capacity being a requirement in these countries for admission to examinations for the license to practise. The system has been in successful operation at The Johns Hopkins Hospital since the opening of the medical school.

It should be emphasized that the system, unlike that of ward classes, constitutes a part of the regular, orderly machinery of the hospital, that the students do work important for the interests of the patient and which, if not done by them, would have to be done by others. How important this kind of clinical training is deemed by that country which has long held the leadership of medical science is indicated by the recent addition in Germany to the formerly required period of study of the so-called practical year of continuous service in a hospital before the student is eligible for the license to practise.

I believe that it is incumbent on our medical schools and public hospitals to furnish students with opportunities for the kind of clinical training which I have briefly sketched and have indicated as comparable to the laboratory method of teaching. Let us briefly consider what objections can be urged against this method of clinical training and what obstacles stand in the way of its general adoption in this country.

The difficulties are not to be sought primarily in the lack of desire or willingness on the part of medical schools to advance along these lines of improved clinical teaching. It may be that the advantages of the newer methods are not so widely and fully appreciated as is to be desired, but the leaders and especially the younger generation of clinical teachers are alive to the importance of reform.

The difficulties and objections come from that other essential arm of medical education—the hospitals. Under the prevailing system of medical education in this country the most valuable asset of a medical school is the

possession of an endowed, good general hospital, the appointments to which are controlled by the school and a main purpose of which is to serve the interests of medical education, while serving the best interests of the patients. There are a few hospitals which stand in this relation to a medical school and of these still fewer capable of furnishing the requisite clinical opportunities, for it is self-evident that the system of ward work which I have outlined is practicable only when the ratio between the number of patients and the number of students does not fall below certain limits.

Most of our schools must look to outside public hospitals to aid them in this most important part of the training of medical students, and the appeal of the schools and the students, an appeal which should be supported by the entire medical profession, is one which should receive the most careful consideration from the trustees of these hospitals. The source of the appeal should be heeded. Our medical charities could not exist without the free gift of these services by physicians, and the mere pecuniary value of these services, amounting annually to many millions of dollars, exceeds that of all the funds contributed to their endowment. The welfare of the community is vitally concerned with the supply of well trained physicians, never so much so as today when the power to relieve suffering and to check the incalculable waste to society from preventable disease has been greatly increased and is constantly growing. If the public wants good doctors it must help to make them

A hospital which includes, as most public hospitals do, among its recognized legitimate functions not only the care of the poor sick, but also the training of physicians and nurses and the advancement and dissemination of medical knowledge adds no function which is new in principle when it admits advanced undergraduate students to work in its wards, while by so doing it greatly increases its usefulness and service to the community, and I believe also to the patients. There is no very material difference between the qualifications of these advanced students to undertake this work and the qualifications of internes when first admitted to the hospital staff. The introduction of these students into the hospital in accordance with the plan of ward work recommended interferes in no way with the orderly discipline and quiet of the wards.

The objection concerning which the greatest misapprehension exists and which doubtless weighs heaviest in the minds of managers of hospitals and of the lay public, unfamiliar with the actual facts, is the fear that harm will be done to the patients by permitting them to be examined by students. The primary purpose of the hospital is, of course, the care and treatment of the patients and the first duty of hospital trustees and physicians is to the patient. Nothing which prejudices the welfare of the patient can for a

moment be permitted, and if it were true that the kind of clinical training which I am advocating inflicted any injury whatever on the patient, no other considerations could outweigh this objection.

The objection, however, is entirely unfounded. Every one acquainted with the conditions knows that our clinical teachers and the attending physicians and surgeons of hospitals are keenly solicitous for all that conduces to the comfort of their patients and makes for their recovery, every whit as much so for the poor as for the rich. They can be safely trusted to take every precaution to guard patients from harm and to imbue their students from the start with the same spirit of anxious solicitude for the welfare of the patients. A main purpose of the kind of clinical training under consideration is precisely to teach students when and how to examine patients, and I am informed by my clinical colleagues that students are, if anything, overcautious in their anxiety to refrain from any possibly injurious disturbance of the patient and that they carefully observe any directions which may be given regarding patients. Your own Dr. Keen in his admirable presidential address to the Congress of American Physicians and Surgeons on "The Duties and Responsibilities of the Trustees of Public Medical Institutions" expressed himself on this point of possible harm to the patient from bedside instruction in these forcible words:

"I speak after an experience of nearly forty years as a surgeon to a half-dozen hospitals and can confidently say that I have never known a single patient injured or his chances of recovery lessened by such teaching."

So far from being detrimental, the teaching of physicians and students is distinctly advantageous to a hospital and its patients. The teaching hospital is in general more influential, more widely useful and more productive in contributions to medical knowledge than a hospital not concerned with teaching. Such a hospital is more attractive to physicians and surgeons of distinction and, therefore, more likely to be able to attach such men to its attending staff, and thereby secure the best medical service. The stimulating influence of eager alert students on the clinical teachers in hospitals has been so delightfully depicted by Dr. Keen in the address just cited, and which should be widely read by trustees and physicians, that I cannot refrain from quoting his remarks on this point in full. He says:

"Moreover trustees may overlook one important advantage of a teaching hospital. Who will be least slovenly and careless in his duties, he who prescribes in the solitude of the sick chamber and operates with two or three assistants only, or he whose every movement is eagerly watched by hundreds of eyes, alert to detect every false step, the omission of an important clinical laboratory investigation, the neglect of the careful examination of the back as well as the front of the chest, the failure to detect any important physical sign or symptom? Who, will be most certain to keep up with the progress

of medical science, he who works alone with no one to discover his ignorance; or he who is surrounded by a lot of bright young fellows who have read the last 'Lancet' or the newest 'Annals of Surgery,' and can trip him up if he is not abreast of the times? I always feel at the Jefferson Hospital as if I were on the run with a pack of lively dogs at my heels. I cannot afford to have the youngsters familiar with operations, means of investigation or newer methods of treatment of which I am ignorant. I must perforce study, read, catalogue and remember, or give place to others who will. Students are the best whip and spur I know."

There is no teacher who will not subscribe to these words of Dr. Keen.

It should furthermore be emphasized that the efficiency of the teaching hospital in its main function of treating diseased and injured patients is increased not only by securing the most skilful medical staff, by the constant stimulus of their interest and activity and by the spirit pervading the institution, but also by the participation of advanced students in the work of the dispensary and the wards in accordance with the system of clinical training which I am urging on your attention. When one considers all the time-consuming microscopical, chemical and physical tests applied in modern diagnosis and necessary to secure complete records of cases of disease, it can be readily understood that the increased force of those trained to make these examinations conduces to more accurate diagnosis, and to more satisfactory control of the progress of the patient from day to day, and therefore to better treatment. In advocating improved methods of clinical training and the introduction of such training more generally into public hospitals I plead and plead earnestly for the student, but I plead also for the hospital and the patient.

It is really lamentable to contemplate the immense clinical material which exists in the public hospitals of our large cities and which could be made available for the education of students and physicians and for the advancement of medical knowledge, but which is utilized for these purposes either not at all or very inadequately. Medical schools of these cities do not begin to secure the advantages of location which rightfully belong to them and they allow themselves to be outstripped by schools less favorably situated and the hospitals themselves are less useful than would otherwise be the case.

I am well aware of the practical difficulties in establishing the necessary relations with hospitals not already connected with medical schools. These difficulties, however, are not insurmountable if the trustees, teachers and medical staff sincerely desire their removal. The new order doubtless involves readjustment of existing conditions both in the schools and in the hospitals concerned. In many instances there will follow a considerable increase of the force of clinical teachers and a wider recognition of work done outside of the college walls and of the immediate direction of members of

the faculty, a recognition, it may be, of something on the order of the Scottish extramural teaching or of the German privat-docent system, but adapted to our own special conditions. Careers will be opened to hospital physicians and surgeons, especially to young men, ready and fitted to teach but who now find the doors closed to them.

My remarks thus far have related mainly to the needs of undergraduate medical students and to methods of undergraduate clinical teaching. Education at best is only begun in the school, and the most the medical school can hope to do is to send its graduates forth fitted to begin their professional work and to continue their lifelong education with the greatest advantage to themselves and to others. I have on another occasion discussed the serious lack of opportunities in this country for the training of young men who aim at the higher careers in clinical medicine and surgery, and I contrasted these opportunities with similar ones now open in our laboratories for those who desire to become teachers, investigators or directors of laboratories of anatomy, physiology, pathology or other medical science. Training for the higher clinical careers requires a long apprenticeship after graduation from a medical school and after the ordinary hospital interneship and is best secured by prolonged service in a hospital as resident physician or surgeon under conditions which secure more thorough practical experience and better opportunities for scientific study and investigation than those which now exist under the customary arrangement of the medical staff of our hospitals. I shall not now occupy time by renewed consideration of this aspect of my subject further than to state my belief that the reorganization of the resident and interne medical staff of the hospital indicated for this higher training of graduates of medicine is also that best adapted, if not essential, for the successful operation of the system of ward work for undergraduates which I have sketched and for the highest efficiency of the hospital.

A teaching hospital, such as the new Jefferson Medical College Hospital, will not be content solely with making the best possible provision for the treatment of injury and disease and for imparting knowledge, it will recognize as one of its most important functions also the increase of knowledge. Although I am approaching the end of the time allotted to this address, I cannot pass this subject by without reference, albeit necessarily a hurried one.

For purposes of accurate diagnosis and treatment by modern methods a general hospital must nowadays be supplied with no small equipment for clinical laboratory examinations, and a good pathological laboratory is now generally recognized as essential to such a hospital even in its routine work. Practical courses in the clinical laboratories are among the most valuable additions of recent years to the medical curriculum.

The problems of disease presented by living patients are the most difficult and complex in the whole range of the physical and natural sciences. Much light can be shed on them by investigations conducted in physiological, chemical, pathological, pharmacological and bacteriological laboratories, especially by experimentation on animals, but it is increasingly clear that the scientific study of many of these problems can be undertaken with the greatest advantage in well equipped, special laboratories connected with the hospital clinics and in charge of investigators trained in chemical, physical and biological methods, with convenient access to the material for study and in close touch with the clinicians. I may cite as good examples of such laboratories those of the University Clinic in Munich under the direction of Professor Friedrich Müller.

The familiar analytical and statistical study of cases of disease, based on simple clinical observations, and first extensively and fruitfully applied by the great French clinicians of the early part of the last century, has been of immense service to medicine and will continue to be of service. A good clinical observation has precisely the same scientific value as a fact demonstrated in the laboratory, and, even if more difficult of interpretation, is often the safer guide for the action of the physician.

It is, however, from the special clinical laboratories that we may reasonably hope for a more penetrating insight into the causes and nature of many diseases, an insight which perhaps may arm physicians with a saving power of prevention and treatment of some of the organic diseases of advancing life comparable to the inestimable gifts of bacteriological laboratories to the prevention and treatment of infectious diseases. We must welcome the establishment of such laboratories and the new directions which they are giving to medical research. When the purposes of such laboratories are made clear, their foundation and support should make an especially strong appeal to public and private philanthropy.

The medical laboratories of whatever kind and the clinics, while each must cultivate its own special field, are fundamentally one domain, one in their scientific methods and spirit and one in their common purpose to advance medical knowledge and thereby bring healing to the nations.

In this great domain and with this high mission may the Jefferson Medical College and Hospital, with their past of honorable achievement and their future of larger opportunities, grow and prosper, serving skilfully the sick under their care, and blessed with wise counselors, with able and devoted teachers and contributors to medical science and art, with zealous students from far and near, and with loyal graduates—an institution standing in this community and throughout the land as a powerful influence for all that is best in our profession!

THE HOSPITAL IN RELATION TO MEDICAL SCIENCE [1]

The formation of a section to be devoted to the consideration of hospital problems is to be welcomed as meeting a real need of the profession. Hospitals have played an important part in the past and are destined to play a much greater one in the future in the advancement of medical science and art and in the promotion of medical education. In recent years they have assumed interesting and significant sociologic functions, and it is possible that it may hereafter be deemed wise to add the subject of medical sociology to the title and functions of this section. Certainly there should be some section in which this important subject may receive proper consideration, and it does not seem desirable to multiply the sections of the association more than is absolutely necessary.

The various activities of the hospital may be classified as humanitarian, scientific and educational. Although included in the foregoing, it may be well to specify also the sociologic activities. The most widely useful hospitals are those which recognize and give their proper share to each of these functions.

The position held by the superintendents of many of our hospitals is, I believe, peculiar to American hospitals. This position is one of much larger influence and authority and of more varied functions, not only on the administrative but also on the professional side, than any corresponding one in European hospitals. As a rule the superintendent comes into much closer relations with the trustees or managers of the hospital than do members of the professional staff. His opportunities and power for good, as well as for harm, are very great. For the position of hospital superintendent, as it has developed in this country, at least in the larger general hospitals, it seems to me most desirable that a medical man of good administrative capacity should be chosen. The career has become a highly specialized and in many respects an attractive one. A medical superintendent should be the one most likely to appreciate and further the needs of medical science and education.

The care of the sick and injured is the primary and essential purpose of a hospital. The welfare of the patient should always receive the first consideration. The plea for scientific and educational uses of a hospital could

[1] Report of remarks made by invitation at the Opening of the Section on Hospitals of the American Medical Association, Atlantic City, June, 1912.

J. Am. M. Ass., Chicago, 1912, LIX, 1667-1668.

not be justified if it could be shown that such uses interfered with the patient's welfare. As a matter of fact, however, one of the strongest supports for this plea is the demonstration, based on experience and sound argument, that the interests of patients are best served in hospitals which likewise recognize fully the needs of medical education and of scientific research. The best and most famous hospitals are of this character, and such hospitals serve the community more broadly and effectively than institutions which limit their activities merely to the care of patients.

The most urgent problems of medical education today relate to the teaching of the clinical subjects. It is the so-called theoretical or laboratory subjects which are now taught most practically, whereas the practical branches are taught most theoretically. In the past, hospitals and medical schools in this country have developed, for the most part, quite independently of each other, and as a result it has become a matter of great difficulty to bring them together in some such relation as that existing in Germany between university and hospital. The need of such affiliation is now widely recognized and efforts to solve this perplexing problem have in some instances met encouraging success. The solution does not in general lie in the direction of universities securing hospitals of their own, although they are fortunate if they possess them but rather in the establishment of the proper relations between the universities and municipal or privately supported hospitals, whereby such hospitals can be made freely available for the training of students and physicians and the cultivation of scientific medicine.

We can scarcely point today to the existence in this country of great medical and surgical clinics comparable to those of most German universities, nor shall we have them before there has been considerable reorganization of the professional service in most of the teaching hospitals and until we recognize that the head of such a clinic cannot conduct it properly as a mere incident of a busy outside practice. It is a curious fact that, whereas every other branch of the medical sciences has now assumed the position of a science to be cultivated by those devoting their lives to the subject, clinical medicine, the main trunk from which all these branches have sprung and the most important of all the medical sciences, has not yet assumed this rank of an independent science requiring for its cultivation and teaching the single-hearted devotion of those who pursue it.

The heads of the departments of medicine and surgery in the university should of course be the heads of the corresponding clinics or services in the hospital, and in my judgment these positions should go to those who are willing to give most of their time to the care of patients within the hospital, to teaching and to the supervision or conduct of investigations relating to

their science and art. They should be provided also with a resident staff superior to the ordinary internes and comparable to assistants in laboratories, who are appointed for longer periods and are in training for academic careers or the higher walks of medicine. Under such a system the hospital and the patients will be better served, medical education will be improved, and the art and science of medicine will be advanced far more than under the prevailing conditions. It is not enough that we should ask ourselves whether our medical schools and hospitals turn out as good doctors as those of Europe; we should also inquire whether they are contributing their share to the world's progress in the art and science of medicine. The problems of clinical medicine are of an interest and importance surpassing those of any other branch of medical science. For their solution the hospital ward should be the laboratory, but at present the organization of work in the ward bears so little resemblance to that of a scientific laboratory that a comparison between the two is only misleading.

A tendency at the present time to separate scientific research from the work of teaching has certain advantages, but has, I believe, even greater dangers. Scientific investigation in medicine during the last three decades has led to results of such vast importance as regards our power over disease that this makes an appeal to the public and to philanthropists much stronger than does medical education. Hence it is that large funds are available for institutes of research and for research hospitals which have no connection with education. Hospitals are often more eager to contribute to scientific medicine than to participate in the work of medical education, and in a number of instances have been provided with funds and laboratories intended solely for scientific research. While there is room for such independent endowments and institutions, the roots of fruitful scientific work lie in the educational system, and if the latter is neglected, the former will suffer. The traditional home and the most favorable environment for productive research is the university, and hospitals in affiliation with universities offer, I believe, the best opportunities for the promotion of medical science and art. Above all the teacher should also be an investigator.

The provision of laboratory equipment has become a necessity of the modern hospital. Modern methods of diagnosis require in ever-increasing measure trained experts and the necessary rooms and equipment for biological, physical and chemical diagnostic procedures. Development along these lines has greatly improved the quality, both scientific and practical, of the work of our hospitals, and leads naturally to the desire to combine scientific investigation of the problems of disease with the practical aims of the hospital. This is a line of progress which should be encouraged by our hospitals, and which increases the service of the hospital to the profession and the public.

I think that a special plea is needed at present for the cultivation of pathological anatomy, which has not, as some seem to suppose, exhausted its possibilities of usefulness in the advancement of scientific medicine. It is not necessary to decry the value of experimental and physiological methods in order to give to pathological anatomy its proper place in the study of the problems of disease. Every effort should be made to secure postmortem examinations of those who die in hospitals, and in my experience such efforts, if properly made, are generally successful. Both hospitals and the public—I might add, even the profession—should be educated to a realization of the importance of such examinations, so that they are understood to be a matter of course in the conduct of the hospital.

Although but little appreciated as yet by the community, medicine is destined to play a leading part in the solution of many of the industrial, economic and social problems of the world, and in these newer activities, to which I referred at the beginning as sociologic, there is a place for the helpful cooperation of our hospitals; but I must leave this aspect of the subject to your consideration with this bare mention.

In conclusion, permit me to express my best wishes for the success of this new section, which opens with a program indicative of much useful work.

ADVANTAGES TO A CHARITABLE HOSPITAL OF AFFILIATION WITH A UNIVERSITY MEDICAL SCHOOL[1]

The Presbyterian Hospital of New York City is fortunate, and Columbia University is fortunate, in the alliance that has recently been effected between the work of medical instruction as conducted by the College of Physicians and Surgeons, Columbia University, and the clinical work of the Presbyterian Hospital. The affiliation is significant from several standpoints. One of its most important features is the complete realization on the part of the hospital managers and trustees as to the broadened functions which a general hospital can serve by affiliation of this kind, and their expression as to what should constitute an ideal hospital—that it shall serve not only in a restricted sense the philanthropic and humanitarian purposes for which all hospitals are created, but also in a more extended sense the educational and scientific needs of medicine. Medical men have held views regarding the part played by managers and trustees of hospitals, in so far as the duties and responsibilities of these positions are concerned, to the effect that trustees sometimes fail to realize fully the great measure of service which a hospital can fulfill not only to the sick within its walls, but also to the community as a whole; but, as expressed in the terms of agreement between the two institutions, the managers of the Presbyterian Hospital have arrived at a full recognition of a wider responsibility:

"The parties to this agreement are united in the belief that a permanent alliance between the hospital and the university will render the hospital more useful, will enable it to serve the needs of both patients and the community more efficiently, will secure the best professional service for the hospital and will make the hospital the center of larger ideals by promoting education, by advancing knowledge, and by exemplifying the best in practice. And also that such an alliance will benefit the university by enabling it to give the best clinical instruction to its students, and afford improved opportunities for advanced study."

Again, the affiliation is significant because it means that a long step forward has been taken toward the solution of the most urgent problem of medical education in this country today—the establishment of such relations between hospitals and medical schools as shall make hospitals more freely available for teaching and training physicians and medical students. That

[1] An address delivered at the Forty-third Anniversary of the Presbyterian Hospital, New York City, December 2, 1911.

Survey, N. Y., 1912, XXVII, 1764-1770.

need has been long recognized and the hospitals have not been altogether indifferent to it. Nevertheless it has not been clear how cooperation between medical schools and hospitals could be effected.

Owing to the fact that our hospitals and medical schools have drifted apart, it is difficult at the present time to arrange affiliations between them. This separation of functions did not exist at the beginning. Indeed it is curious to observe how correct were the ideals of the medical schools in this country in the eighteenth century. Both at King's College in New York, and at what is now the University of Pennsylvania, the essential need of combining clinical instruction with the teaching of the medical school proper was recognized. Later the institutions furnishing these opportunities drifted apart. For this reason, I feel that in solving its own problems the Presbyterian Hospital has done a great service to medical education in America, because it has indicated how the problem can be solved elsewhere, not necessarily on precisely the same terms, but along the same general lines.

The arrangement that has been made is of significance not alone to the community in general but to New York City in particular. It has been a matter of wonder generally that New York City has not fully realized and utilized her great possibilities for medical education. In New York City hospitals the largest amount of clinical material in America is collected; and how little use has been made of it! In consequence, the metropolis does not occupy, or it has ceased to occupy, the leadership in medicine which its location and opportunities justify it to claim. But this alliance means that the first adequate measures have been taken to secure New York City the preeminence in medicine which belongs to it by virtue of its position.

The type of hospital contemplated by the alliance is in no sense an experiment. Throughout the world, the hospitals of the largest usefulness to the community are institutions which have combined the humanitarian with the educational and scientific interests of medicine. They are the hospitals that have made the most important contributions to medical science and that have won the greatest reputation. Such are the hospitals of France, of Vienna, Berlin, and London. Guy's Hospital in London, which is of this type, to some extent, initiated these conceptions in Great Britain. It was there that men like Richard Bright, Addison, and Hodgkin made their clinical studies and their contributions to the advancement of medicine. In this country The Johns Hopkins Hospital of Baltimore has pursued similar ideals, so far as its resources permitted. Each and every hospital of this category has rendered eminent service not alone in the care of the indigent sick, but in the training of medical men and in the promotion of medical knowledge. The affiliation does not, therefore, mean that the hospital is

entering upon a field of work wholly unexplored, nor does it mean the undertaking of tasks that have not already been demonstrated to be entirely practicable.

Let us consider in detail the three principal functions of the ideal hospital—the care of the sick, the adequate training of the medical men of the future, and the advancement of medical knowledge.

The care of the sick stands first and is never to be forgotten, for the welfare of the patient is the primary purpose of the hospital. If it could be demonstrated that the addition of the educational and scientific functions in any way impaired the service of the hospital in its care of patients, thus lessening the humanitarian to the advantage of educational aims, then it would be clear that the introduction of the new functions would not be justified. There is practically no division of opinion among medical men as to the influence upon hospital service of these additions; but laymen are apt to conjure up in their minds conditions under which the inroads of medical students into a hospital would be disturbing to the order and quiet of the wards, and where the examination of patients for purposes of teaching might be harmful to the sick. For these alleged reasons the public may be induced to pause, at least, before accepting the idea that the use of a hospital for teaching increases its value in the treatment of patients. But those who have had experience know that nothing is further from the truth than such a conception of reduced service, for it has been demonstrated that, instead of weakening the humanitarian efficiency, the educational and research functions increase the value of the service which a hospital fulfills in the care of its patients. As has already been stated, one of the reasons why ward patients are better served by the new arrangement is that the hospital is in a position to secure for its wards the very best professional service available; and by a permanent agreement of this kind the best professional service is secured not only for the immediate present but for the future. A hospital of this type will not only have the most talented men on its staff, but the men will also be of a distinctive type—not necessarily better practitioners, but men singularly devoted, who realize that their first duty is to the allied interests of the hospital and the school, and that their life work and main enjoyment are to lie in the practice of medicine in the wards and private rooms of the hospital, in teaching medical students, in the advancement of knowledge, and in the development of their departments of medicine. They are men who will not become absorbed in a large outside practice, be it even a consulting practice, which would interfere with this work. If, then, the hospital secures men of this type, who are to give their lives to the service of the patients, will not the hospital be better served, will not the ward patients be better cared for? The presence of the students in the wards will

also tend to the better care and treatment of the sick and injured. From the method which is essential for the adequate training of medical students today great advantage is derived by the patients, because the latter are studied more carefully and thoroughly. The more thoroughly they are studied, the more will be known about the diseases that afflict them, and the better will be the chances of successful treatment. It is, therefore, beyond dispute that a teaching hospital connected with a university medical school makes better provision for the care of its ward patients than a charitable hospital with no other aim beyond the care of the indigent sick, important as that is.

Second, as to the education of medical men: Hospital educational work is not altogether new; it has been carried on in many hospitals, but in the past there has been very inadequate recognition of this inexpressibly urgent need at the present time. The urgency is due partly to the demands made by improved methods of teaching which are not alone applicable to medicine, but are recognized as sound pedagogy in all branches of knowledge. They involve in the main the principle that vital knowledge—which enters into the fiber of being and give power and wisdom—can come only from intimate contact with the objects of study; that being told or reading about things does not supply that knowledge, nor does demonstration alone meet the need. The student must touch; he must see for himself; in a word, he must come into close and intimate personal relationship with the object of study in order to acquire the saving knowledge which, in this instance, is for "the healing of the nations." The clinical teaching in the hospital will consist not merely of amphitheatre clinics and "ward classes"—groups of students accompanied by their instructors taken for an hour or so through the wards. These procedures, while useful, bear about the same relation to the teaching I have in mind as in science demonstrations bear to practical laboratory work. Students are not enabled to make suitable examinations and interpretations of what they see by that kind of instruction, any more than a student of bacteriology would be made efficient by merely being told how to make his cultures or how to inoculate media. He must do the work with his own hands. In order to have in the clinical work the same kind of practical teaching which has been so useful in the laboratory, it is necessary that students be introduced into the hospital wards and have patients assigned to them for study. At the period when students are thus admitted into the wards they are not materially less fitted to work there than is the ordinary interne when he begins his work. This practical teaching begins usually in the fourth year of the medical school, when the students have already been taught the methods of physical diagnosis; they have already had opportunities of study in the out-patient department of the hospital. They come,

therefore, not ignorant; and they work always under the close supervision and control of heads of departments and their associates. In the wards, students take clinical histories, make examinations of patients, and analyses of blood and other body fluids—taking charge, in fact, of a part of the routine necessary for the orderly working of the hospital. This is work which must be done, and if it were not done by students others would have to be engaged to do it. This organization of students' work in the hospital is the system of clinical clerks adopted in this country from the British hospitals. Notwithstanding the defects of medical education in Great Britain and the inadequacy in many respects of its medical schools, the British hospitals have the one great glory of having contributed the method of clinical clerkship in the wards of the hospital; and for that reason good doctors are trained in Great Britain. The method, which was introduced into America at The Johns Hopkins Hospital by Dr. Osler, is the most important contribution the latter institution has been able to make to the advancement of medical education in America.

Another reason why the need for practical medical education is more urgent than ever before lies in the progress that the science of medicine has made. New methods of diagnosis and treatment have been discovered or invented which require the use of technical and precise instruments; and these methods can be acquired only by practice.

I should be inclined, also, to enter among the educational functions of the hospital the training of younger physicians and surgeons for higher clinical positions. There is nothing in clinical work which quite corresponds to the opportunity for the training of men and women as anatomists, physiologists, or pathologists. A young man who contemplates following the career of a pathologist must serve as assistant in a laboratory for a number of years. One of the great needs in the development of clinical medicine is the affording of opportunities to those with proper aptitudes and possibilities who desire to follow such careers—not necessarily academic—in the higher walks of clinical medicine and research. The Johns Hopkins Hospital has endeavored to supply that need by creating a resident staff consisting of a resident physician, surgeon, gynecologist, with two or, it may be, three assistants. These physicians, who are above the rank of the ordinary internes, are appointed for indefinite periods and their positions are more or less permanent. They study for years and when they leave they have often established their reputations by published contributions.

Doubtless those who are engaged in teaching clinical medicine in this country feel that we make as good doctors in America as anywhere else in the world. I am not prepared to gainsay that statement; but I do not believe that we have developed clinical medicine as a science and an art as

is done elsewhere. I do not think it can be shown that this country has made such important contributions in the improvement of methods of diagnosis and treatment as have been made elsewhere.

The advancement of knowledge is the third important function of the ideal hospital. On account of discoveries which have been made and the possibilities they have created for increased knowledge as to the cause, nature, and treatment of disease, medical science today makes the strongest possible appeal to philanthropy—a social appeal which it could not have made thirty years ago. The new knowledge that has come as to the cause and spread of one particular class of affections, infectious disease, is of vast social import, because it affects a large majority of the population, and especially the young and those who are in the most active working period of life. This knowledge has become a benefit to mankind, for it has prolonged life and increased human happiness. Since the first actual records were taken in New York City in the middle sixties, the rate of mortality has been reduced from thirty-five deaths per thousand inhabitants to about fifteen. What does that signify? It means that some twelve years have been added to the average period of human existence. This reduction in mortality is the sequence wholly of our control of infectious diseases. The saving thus made relates only to the period of life under fifty years. We have no such saving knowledge regarding the organic diseases of advancing years which afflict especially those who have been most active in affairs and who have large responsibilities. The ideal hospital can be a workshop for new knowledge in that direction.

In response to this almost irresistible appeal to philanthropists to furnish resources for investigation in medicine, so as to increase our knowledge of human pathology, independent institutes of research have been established; and they have justified their existence by the results that have been achieved. But in these independent institutes there is danger of losing sight of the intimate and close connection that must exist between education and the advancement of knowledge: It is not possible to further the advancement of knowledge effectively and do nothing for the advancement of education. The roots of fruitful research must lie deep down in the educational conditions of our institutions. We may well ask whether in the past our hospitals and medical schools have furnished the most suitable environment for research. Is it not to some extent the inadequacy of conditions existing in our universities, hospitals, and medical schools which has led to the establishment of these independent institutes? In my judgment, the most suitable as well as the historic place for investigation is the university; its ideals and environment should furnish the best atmosphere for careful work of this kind. I am in sympathy with those who believe that the medical school and hospital

should be in close proximity. That is not saying that existing arrangements will not do much good, but it would be far more useful if the hospital and medical school were close together. It is not merely a matter of convenience but a matter of the whole atmosphere and spirit of the institutions. The stimulus given to those engaged in the work of the hospital wards will be far greater if they are in close touch with the laboratories of the medical school. I should like to see the College of Physicians and Surgeons and the Presbyterian Hospital situated side by side, and the destiny of the two institutions brought closer together.

These new resources and opportunities—important as they are—are only the beginning of things which one can picture; they represent nothing that is final. As the result of this alliance an appeal for support three-fold stronger than ever before should be made. Those whose interests are along philanthropic lines should be even more interested than they have been in the past, because, as has been stated, the humanitarian service of the hospital will be greater than ever before. Those who realize the great service which the alliance means to medical education and hence to the community should feel that here is a most rewarding opportunity to aid by adding to the resources of the hospital and medical school. Those whose interests lie in the advancement of knowledge, and who realize what the possibilities are for the advancement of the welfare of mankind in adding to our knowledge of the intimate nature and causes of diseases, with a prospect of better methods of prevention and treatment, should feel that here is an unsurpassed opportunity to contribute in that direction.

From the three points of view—the philanthropic, the educational, and the scientific—the work contemplated is full of the highest promise. Undoubtedly many new problems will be created which, if it is realized that the interests of the hospital and the university are fundamentally common interests, will be solved by a just spirit of cooperation between the two institutions, each preserving its independent corporate existence. I feel that I am expressing the thought of all those interested in philanthropy and in education when I voice the hope, a hope which is almost an assurance, that under the new conditions of affiliation the ideal hospital may be evolved.

FORMAL OPENING OF THE PETER BENT BRIGHAM HOSPITAL[1]

Mr. President, Members of the Corporation and Staff of the Peter Bent Brigham Hospital, Ladies and Gentlemen.—It is a great pleasure to me to be permitted to participate in these exercises. I understand that the present occasion is the first public opportunity to extend congratulations to the members of the corporation of the hospital and to the city upon the completion and opening of an institution which is the product of much thought and of a large expenditure of skill and knowledge from many sources.

I am informed by those who are expert in such matters that in construction, administration and planning this hospital is original in many respects and that it makes a valuable contribution to the general subject of hospital development. The name of its founder, Peter Bent Brigham, will be perpetuated through its great service, not only to this community but to mankind, and all who are interested in the advancement of medical education will hold his name in grateful remembrance. But a year has passed since it was actually opened and already its aims and ideals have become manifest and a considerable amount of work has gone forth from it; so that even after this short interval of time it ranks among the leading hospitals of the country.

I wish especially, Mr. President, to commend the wisdom of the members of the corporation in locating the buildings in close proximity to the Harvard Medical School, and in establishing such a relationship with the school that the hospital will best be enabled to serve the high purposes of medical education. The mutual advantages to the hospital and to the school through this association are perhaps obvious enough to require no comment on this occasion. The advantages to the hospital, however, may not be quite so apparent to those who are not sufficiently informed; for often, I think, the general public, and indeed the trustees of hospitals, do not realize the larger humane work in the care of the sick poor which a teaching hospital is able to carry out. But by such an affiliation its primary purposes are best fulfilled, and therefore the humane intentions of the founder of this institution are more perfectly realized than would be possible had the buildings been located elsewhere. In the first place, the arrangement by which the heads of the departments of medicine and surgery in the medical

[1] Report (uncorrected) of an address delivered at the Formal Opening of the Peter Bent Brigham Hospital, Boston, Founders Day, November 12, 1914.

Peter Bent Brigham Hosp. Pamphlet, Bost., 1914, 8-12.

school are also in charge of the work in their respective clinical departments enables the hospital to secure the best possible skill and knowledge in the care of its patients. And on the other hand, the creation in a teaching hospital of a modern general medical and surgical clinic—bringing young men into training for the higher walks in clinical medicine and surgery—means a far more thorough study and diagnosis of disease and therefore better treatment of the patient than would otherwise be possible.

One can understand how the lay public might feel that it was detrimental to the interests of the patient for students to have access to the wards; but through abundant experience we know that the opposite is really true; for where students actually become a part of the working force of the ward and perform such duties as the taking of histories and examining the blood and secretions, which would have to be done in any case—becoming, as Dr. Osler has expressed it, a part of the working machinery of the hospital itself—they are doing work which is not only beneficial to their training, but which at the same time is conducive to the welfare of the patient.

How much larger, then, is the service to the community when the hospital adds to its other function educational and scientific aims; when it contributes to the training of medical students and of men already graduated in medicine who are preparing for further careers in their life's work, and at the same time is so organized as to advance the science and art of medicine.

In establishing a teaching hospital, closely affiliated with a great medical school, you have contributed to the solution of one of the most urgent problems of medical education today. The progress which has been made in this direction during the last twenty-five or thirty years is most gratifying, and a pioneer in this forward movement has been the Harvard Medical School. I have heretofore had occasion, and should like again, to speak of the debt which medical education owes to the President Emeritus of Harvard University; and it is indeed a great satisfaction to know that Mr. Eliot's successor is also keenly interested in its problems and that the leadership of the school in the future is thus secured.

But great as our progress has been, we have not overcome all of our difficulties. The problem of the adjustment of professional to collegiate education in this country, which arises largely, I think, from the fact that for a long time the colleges and professional schools developed so widely apart, we have not yet satisfactorily solved. Nor have we solved the problem of the establishment of a suitable relationship between the medical school and hospital, and here again the difficulty is due to the development of the hospital quite apart from the medical school—a division which came about largely in consequence of the unfortunate line of development of medical education during the greater part of the nineteenth cen-

tury. Some of the schools and universities have established, and hold and administer, their own hospitals; but I do not think that this can be regarded as an entirely satisfactory solution, for the administration of a hospital is really not a function of a university. In Germany, where the large government hospitals serve the purpose of medical teaching, the problem has, of course, been met in this way. The great clinics in Vienna, Munich, Berlin, etc., are established in hospitals supported by the government, municipal or state, which considers it a part of its function to provide for the medical instruction; but in this country we have accomplished very little in the way of bringing the large general municipal hospitals into a proper relationship with medical teaching. Much is to be expected in the future, I think, from a more enlightened sentiment in regard to the subject; but for the present it would seem that we must look for most encouragement from a close association between the privately endowed hospital and the medical school. At The Johns Hopkins University we have always considered that the greatest asset of our medical school is the hospital. By a very wise clause in his letter of instructions to his trustees, Johns Hopkins provided that the hospital was to be a part of the medical school, for which he had already made provision in his will in connection with the university; and it may be said that the relationship has been in all respects satisfactory—at least it has never been one of our problems to bring the two institutions into close harmony.

Elsewhere efforts have been made in this direction, in New York, for example, to bring the Presbyterian Hospital into proper affiliation with Columbia University and the New York Hospital with the Cornell Medical School, and recently in New Haven to bring the New Haven Hospital into close association with the Yale Medical School. This has meant, of course, a large expenditure of money, and I do not understand that the path has been without difficulties or that it will be altogether smooth in the future, but at least the step is in the right direction.

And hence I consider that the corporation of the Peter Bent Brigham Hospital, in showing that a recently established hospital can be brought into a close relationship with a great medical school, has not only rendered a very large service to the Harvard Medical School, but has made a valuable contribution to medical education in general in this country; and the renown of the hospital and its usefulness to the community will be greatly enhanced by its wise decision.

The establishment and opening of the hospital comes at a most opportune time—at a time when emphasis is laid on the need for improvement in medical teaching. Rather markedly in the past it has been the development of the laboratory which has characterized medical advancement in this

country. We now have anatomical, physiological, pathological, bacteriological, hygienic and chemical laboratories which in our better schools are in many respects the equal of those existing anywhere. The teaching in these laboratories, at least from the experimental side, is at least as good as, and I am inclined to think it is better than, the teaching in any of the schools in Europe. At the same time, of course, there have been valuable contributions from the clinics in this country; but the feeling has arisen that the time has come for a considerable improvement—for something which perhaps might be designated as a reform—in the hospital clinic.

This feeling is due to many causes—in largest measure to the progress of medical education itself—to the great advance in scientific medicine. And it is the result also of a better comprehension of educational requirements, through which it is felt that the older methods, consisting chiefly of didactic lectures, amphitheatre clinics, and more recently ward classes, valuable as they are, do not suffice for the needs of modern clinical teaching. It is felt that the thorough study by modern methods which is necessary in the care of the patient and the better methods of teaching, require the almost undivided attention of those in charge. I do not believe that the director of the modern clinic will have time to engage in any occupation other than his work in the hospital, in the school and in the clinical laboratory. The time has gone by when the great clinicians, those who stand before the community as the great consultants, can at the same time be the heads of departments in the schools and hospitals. Theirs is a different career. There is still room in the hospital and medical school for those engaged in practice, but the urgent need is for a staff of highly trained men who shall devote their entire time to the advancement of knowledge in their respective subjects. I know that this is realized to its fullest extent by the heads of the departments of medicine and surgery in this hospital, who are giving their full time and attention to their work in the hospital and in the school. They have full appreciation also of the greater question beyond the mere supply of a hospital to a medical school, of what use will be made by the medical school on the one hand and by the hospital on the other of this association. The opportunity is obviously before you. But already the ideals of the Peter Bent Brigham Hospital have become manifest, and I am convinced that it will contribute largely to the future advance of medical education and to the welfare of mankind. And what greater aim can there be than this?

THE STATE REGISTRATION OF TRAINED NURSES[1]

I knew nothing of this very interesting movement to secure state organization on your part, with special reference to securing legislation to guard your interests, until the other day when Miss Nutting told me about it, and, as soon as I heard the facts I was extremely interested and I deem it a privilege to be here and to express my interest in this movement. I feel confident that it will succeed because it is so manifestly right. Judge Harlan has said, it seems to me, all that can be said about this question. I am sure it requires no argument to convince you of the importance and the justness of its aim. Still Miss Nutting has suggested that a few words as to the efforts to secure similar recognition on the part of the medical profession may interest you, and even throw out a few hints to guide you.

In more stable countries of Europe with longer established civilization it has been recognized for centuries that the mere title of doctor of medicine conferred by a teaching body should not carry with it the license to practise medicine, the reason being manifestly that medical schools cannot be absolutely relied upon by the state to insure the capability of the candidate as regards requisite training and knowledge. Therefore in Germany, France and England one will find that there exist boards appointed or recognized by the state which must examine the candidate before he is given the right to practise his profession. The degree of doctor of medicine there does not carry with it a license to practise medicine and many practising physicians in Germany have no degree of doctor of medicine; they are simply licensed by the state, because to obtain the degree of doctor of medicine does not require so severe an examination as does the state examining board and it does not mean so much to the physician as a license from the state. It costs a little money and a great many do not take the trouble to procure the degree.

In the earlier days of America it was very important to secure a sufficient number of doctors to provide for the needs of the community and therefore no obstacles were put in the way of persons desiring to follow this profession, however imperfectly. Every effort was necessary to secure enough doctors so that when we endeavored to have state examining boards to confer a license to practise there existed large interests which were naturally opposed to

[1] Report of an address delivered before The Johns Hopkins Nurses Alumnae Association upon the occasion of the Formation of a State Association of Trained Nurses, Baltimore, 1903.

Johns Hopkins Nurses Alumnae Mag., Balt., 1903, II, 155–161.

any interference with the existing state of affairs. The lesson which you may possibly draw from this is that the longer you wait to secure state legislation the greater difficulty you will have; that it will be easier this year than it will be years ahead, so that the sooner you proceed in this matter the greater are the chances of success.

These licensing boards are, of course, matters of state legislation according to our form of government; they are of necessity matters of state legislation. We realize that it would be better, if it were possible, as it is not, to secure national control of this matter so that the qualifications should be alike throughout the country, but it has to be left to each state to prescribe what shall be the qualifications of the practising physician. It results in this, that the laws and the specified qualifications in the different states are so diverse that it is almost impracticable for one state setting up high standards to recognize a license which has been obtained in some other state with inferior qualifications and much lower standard. I hope, therefore, that in this state you will aim to secure such standards as are equal to the best. If that is not possible, get what you can, but, if possible, set up a standard that will be recognized not only here but in all the states of the country, so that a nurse who is a registered nurse in the state of Maryland shall by that very fact be recognized as qualified to practise her profession in any state of the union. I do not know that you will encounter the question that we have in the medical profession, that is, the great problem of reciprocity between the different states, but it is a matter for you to consider. The underlying difficulty has been just what I have stated, that the qualifications have been so little uniform in the different states that as a result a physician who has passed his examination and has been perhaps for a number of years practising in a given state finds great difficulty in changing his residence and engaging in practice in another state; he may no longer be able to pass the requisite examination.

Another matter, of course, was the granting of the most liberal recognition of all existing rights to practise under the original law and I take it that that will also be judiciously considered on your part. The great benefits of the law be in the future. Be therefore liberal, I should say, in the recognition of those who are already engaged in the profession. Of course none of those will be required to take the examination at all. Those who meet certain qualifications that you will decide upon will, of course, register, if this law is secured, as trained nurses, without submitting to any examination. The examination will pertain only to those who enter the profession after the law is in effect.

You are only endeavoring to secure for your profession what has already been secured for other professions. You are not therefore asking for any-

thing that is novel, that is experimental, or the application of any new principles of legislation whatever. The conditions differ little as regards nurses than as regards physicians, or pharmacists, or dentists, or lawyers, all of whose professions are amply protected now by the law. It is not for the present and doubtless it will never be considered judicious to prescribe that those who do not meet your qualifications shall be hindered from the practice of nursing. Judge Harlan has explained, that is not contemplated. It is clear that such a purpose would encounter an overwhelming opposition. You ask for nothing of the kind. Everyone is permitted to practise the art of nursing. You simply ask that some definite meaning shall be attached to the term trained and registered nurse, that meaning implying that those qualified to register have had a certain definite training. Now if all training schools in the country had high standards of education, similar periods of study and equal facilities or giving practical training, it might be questioned whether there was any urgent necessity for this registration of nurses. In the earlier days very likely such a need did not exist, but now the very fact that this movement has arisen and obtained in these three or four years since it began such momentum indicates that there is need for making clear in what the qualifications of a trained nurse really should consist.

The art of nursing, as Judge Harlan has stated, is a profession that is of the highest rank. It is one eminently fitted for women, it is one that requires a long period of training, one that requires special qualifications in the way of education on the part of the nurse, and I may say that I consider, although I am not a practitioner of medicine, that there is no improvement in modern medicine which outranks in importance, in its value in the prevention and cure of disease, the introduction of the system of trained nurses. One can put one's finger on great discoveries in medicine, the relation of bacteria, we will say, to the causation of disease, which is of the greatest interest in the progress of medicine, but so far as the treatment of disease is concerned the application of the system of trained nursing counts for as much, if not more than any scientific discovery in medicine. So important is it that it is the main factor in the treatment and management of a number of the important and prevalent diseases. The benefits, therefore, which will come from the passage of this law in a measure are to you as a body of trained nurses, but in larger measure to the medical profession and in still larger measure to the whole community, to the general public. Therefore it seems to me that all the enlightened forces of society should be interested in the furtherance of this great movement on your part.

The details of the law remain to be determined.

As I understand it you are here today to form a State Association of Trained Nurses. I suppose you will consider what shall be the qualifications

for membership in that association. The organization of such an association seems to be an essential measure in providing for such a law. I have glanced over the laws which have been passed in New York and other states that have secured such legislation and find that in most of them the existence of such a state association was recognized.

An important feature of the law is an indication of the requisite preliminary training of the nurse. There may be some of you who will want to set that standard very high and others to set it much lower. I suppose that the minimum standard at present would be a two years' period of study; that anything shorter than that would be regarded as insufficient for the qualifications of a nurse to receive the state right to register.

The great advantage of this legislation will be for you, as it has been for the medical profession, an elevation of the standards of education of the trained nurse. It will not be interfering with the practice of nursing. It will not drive out, I think, the incompetent and untrained nurse, but the lines will be more sharply drawn than now between the unskilled, untrained nurse and the trained nurse, and the community can know whether the person claiming to be a trained nurse really is a thoroughly trained nurse. It will have an effect, of course, upon the inferior training schools, those which none of you here I am sure would for a moment vouch for; schools with only short terms. I understand that there are schools giving only two or three months training and graduating nurses at the end of that time; schools in small hospitals devoted to only one class or a few classes of disease. In that way it is impossible for a nurse to receive the sort of training which can be obtained only in a general hospital.

Also there will be as a result of this law some line drawn between the recognized training schools and those not recognized. They are perhaps better able to do that in the state of New York than in any other state in the Union. They can do that better for medical schools in New York in consequence of the existence of a Board of Regents as the guardian of higher education. Just how you can have a list of the so-called recognized training schools remains for you to consider. Of course you need not specify in your law the training schools recognized in New York, but in the practical working of the law doubtless you will be very much influenced by the New York recognition of such schools. The law should provide therefore that no one is eligible for registration without a specified preliminary training in a recognized training school,—one where the standards are sufficiently high. But you must not, at least at the beginning, make these standards too high, I think, or you will endanger the chances of securing the legislation. You must be liberal in that respect and consider what it is wise to require.

You have to consider exactly how to proceed to secure the state examining board. I noticed in several of the states that the law was almost imperilled by efforts to secure the presence of physicians upon these examining boards. Now I am quite sure that it is not the function of physicians to examine nurses. They have something to say in the training of the nurses; the nurse should not go forth without having come under the guidance of the physicians, but your profession is a skilled profession which requires special knowledge and a special knowledge that is possessed by the trained nurse and not by the physician. Akin as are the profession of medicine and of nursing, they are still distinct professions, and there is no necessity, in my opinion, and there are certain disadvantages, in the requirement that physicians should be members of the examining board. Most of these laws provide that the examining board shall consist of persons chosen, or at least nominated, by the state association, and that seems to me probably the wisest method.

These two features then are the ones which insure that the registered nurse has the requisite training and knowledge. They insure that she has been graduated from a recognized training school, one with proper standards as regards the period of study and practical training. The law further provides that after the nurse has given evidence that she possesses the preliminary training she must pass an examination, not by her own training school, where conditions come in that do not absolutely insure the necessary qualifications, but before a separate and distinct examining board. Those are the essential features of the law as I understand it—the existence in the first place of a State Association of Nurses, in the second place a provision in the law for a suitable preliminary training, and in the third place, passing the examination of a board of examiners, who have not of necessity been the candidate's own teachers.

What objection can possibly be raised against this desire on the part of the nurse's profession? No real objection, but you are likely, I suppose, to encounter some opposition and I suppose that opposition will be based upon the idea that such a law sets up an unjustifiable distinction; that it sets apart a certain class from others. But the distinction is one eminently desirable, namely that the term "registered nurse" shall mean that here we have nurses who possess certain defined qualifications. At present a diploma does not necessarily have such a significance, so that you require protection on account of the inflow into your profession of those who claim the same title without having fulfilled the same qualifications. Therefore this argument, which is the only one that occurs to me, is one that you will be able to meet when you go before the legislature at Annapolis—that you are proposing a distinction, but one based upon right and justice and one that it is

certainly eminently desirable to make. Perhaps the best argument is that of the benefit to the whole community, because the great majority of people at present have no way of determining who are the really qualified nurses, while the institution of the title of "registered nurse" would overcome this difficulty.

From every point of view that occurs to me your movement is one that should have the support and sympathy especially of the members of the legal profession, of the members of the medical profession and of all women who are interested in improving the opportunities for women of higher professional and practical work as indeed skilled nursing is a great field for women's activity. I wish you all success in your efforts, and shall be glad to be of any assistance to you in my power in securing the desired legislation.

PLEA FOR ENDOWMENT OF TRAINING SCHOOLS FOR NURSES AND OPPORTUNITIES FOR SPECIALIZED TRAINING[1]

Mr. Chairman, President of the Board of Trustees of the Hospital, Miss Lawler, Members of the Graduating Class of the Training School, Ladies and Gentlemen.—I esteem it a great privilege to have this opportunity of giving the address at the graduating exercises of our Training School. It is true that the opportunity has been presented to me before, but for one reason or another, and in no small degree in consequence of a feeling of lack of qualification to meet properly the demands of the occasion, I have been reluctant to accept. I am not engaged in the practice of medicine and am therefore not brought into direct contact with the nurses. I have not been active in instruction that some of the doctors give our nurses. Nevertheless, if I may be allowed some personal remarks, I have not been altogether out of contact with the development of trained nursing in this country.

My first contact with it was as an interne in Bellevue Hospital not long after the introduction of the system of trained nursing here—a pioneer undertaking in this country. Miss Hampton, as I knew her then, who did so much service here and to the profession of trained nursing in general in this country, was a pupil in Bellevue at that time. She was more than once good enough to call to my mind the feeble efforts on my part to endeavor to instruct the nurses. Those were the days of Sister Kelly, of whom you have doubtless heard, who came from St. Thomas' Hospital in London to inaugurate the system of trained nursing as it developed at Bellevue. How incomplete it was is evidenced from the fact that there were no trained nurses in the male wards of the hospital, nor was it thought desirable that there should be. However, the revolution effected there, as every place where trained nurses came into the old order of the hospitals, was simply indescribable. Fresh air, light and warmth came in, cleanliness and comfort, and the entire atmosphere of the hospital was changed. From that day to this there has of course been a continuous and really enormous development of trained nursing in this country. I have been very sympathetic, whenever opportunity offered, to be of any possible assistance in the development of the work. I have been especially sympathetic with the efforts to make trained nursing what it is often described as being, and certainly should be—a real

[1] Report of an address delivered to the Graduating Class, The Johns Hopkins Hospital Training School for Nurses, Baltimore, May 24, 1916.
Johns Hopkins Nurses Alumnae Mag., Balt., 1916, XV, 140-147.

profession for women in all that goes to make up the meaning of the term. I do not propose to enter into this question, but it is interesting and it is from that side more than from any other that I have come to know more or less about the development of trained nursing in this country.

In my early days I did a little teaching, as I have intimated. I shall never forget those classes, and the opportunity for instruction which I, as a young interne, had an opportunity of giving to those poor, tired out nurses at the end of their day's work. The class met immediately after the dinner hour, at eight o'clock, and I was expected to talk to them for an hour. I felt that I was doing them some good if, as happened once in a while, I saw some of them dozing. That is an illustration of faulty methods of education—to ask nurses after twelve hours of hard work in the wards of the hospital and a hastily snatched meal, to come and hear an interne instruct them in the duties of their profession. Things have improved very much since then.

When The Johns Hopkins Hospital was opened there were high purposes entertained as to its contributions to trained nursing, as there were to its contributions to medicine, and as there were on the part of the university with its contributions to higher education in this country. What was contemplated and the expectations at that time were admirably set forth in the opening exercises of the training school, which I recall so well, when Miss Hampton in her address set forth the aims and ideals of the future training school, and also Dr. Hurd in his characteristic and apt way gave an excellent talk about the relations of that training school to the hospital. So far as the resources of the training school and hospital have permitted, these expectations have been fulfilled in as large a measure as could have been hoped. I think it is true that our training school has been enabled to make distinct and valuable contributions to the education, both practical and theoretical of the trained nurse.

I would like to say a word on that side of the matter. I have already emphasized my feeling for trained nursing as a profession, and as a profession distinct from that of the practitioner of medicine—intertwined with it of course; but I am sure it is important for the doctor to realize that there are things which the trained nurse knows better, and he should recognize that the nurse is an expert in a profession which, while intertwined with that of medicine, is distinct from it. It is not to be thought of as simply subservient to the profession of the practice of medicine. It stands by its side. I am sure I shall not be misinterpreted when I make that statement as to the independence of the profession of nursing from that of the profession of the practice of medicine.

Since there has been this organized effort on the part of nurses to secure requisite legislation for registration of nurses, etc., there has been at times

criticism on the part even of leaders of the medical profession as to the position which the nurse desired to attain. There was a catch word at one time—one may possibly hear it today—that nurses were being overeducated. Now I think nothing is more absurd than to talk even of the possibility of the overeducation of the trained nurse. That it is possible for a nurse to know too much, to be too highly qualified on the practical, scientific and intellectual side of her profession seems to be highly absurd. I do not suppose that Miss Lawler, or anyone else in charge of the education of nurses, does not think that there is room for very considerable improvement. The great difficulty is that the education of nurses has not been treated as the education of doctors and of college students has been, as a subject for endowment. I would like to endorse what Miss Lawler has said, for I believe the time has come for the need of endowment of our training schools, in order to enable them to meet the now very exacting and important educational demands. The training school for nurses supplies the needs of the hospital for nurses in the most efficient and economical way possible, but the query may be raised as to whether the complete meeting of that demand of the hospital is in every way commensurate with the meeting of the full needs of the training schools. I do not for a moment suggest that the training school shall not meet the needs of the hospital. That of course is the best part of the training of the nurse, but perhaps the hospitals should look upon it as not merely an arrangement by which the nursing needs of the hospital can be supplied, but as an opportunity to train women for a very important profession.

I think the time has come to make a very urgent plea for the adequate endowment on the educational side of the training school for nurses, for adequate physical equipment and an adequate educational staff, and that the nurse shall have the requisite time not only for studying and attending lectures, but for reading; because practical training in nursing as practical training in everything else is, after all, one-sided, and it rests upon certain fundamental principles and these principles must be taught, just the same as in the training for any other technical profession. One is deeply handicapped without the knowledge of the fundamental principles which underlie the practice of any profession. I think the thought of the need of this endowment of training schools for nurses is now entertained widely by those who are engaged in the training of nurses. I have been much gratified since I came here this afternoon, to hear that this thought, which had occurred to me without having it put into my mind by anyone else as a real need is a very familiar one. Miss Lawler says that the alumnae of the Training School are wide awake to this necessity and they are contributing out of their earnings to a fund for this purpose. I do not know

any better basis for an appeal to public spirited philanthropists who are able to give largely, than that the nurses themselves have made a beginning and have already raised several thousand dollors for the purpose. I should like to see this idea for the need of recognizing the profession of nursing on the educational side as a worthy object of philanthropic endowment presented side by side with the needs of medical education.

There is another thought also of which I may be permitted to speak, namely the great broadening of the field of work of the trained nurse. It has broadened to such an extent in some directions that the term nurse is no longer strictly speaking applicable to a good deal of the work, particularly public health work and some of the work of the visiting nurse. I would not suggest for a moment a change in the term nurse, with which so many beautiful associations are connected, but would simply indicate that the work has gone far beyond the field of merely caring for the sick. This of course brings up the whole question which is to the front of specialization in the training of the nurse. I think the problem is identical, particularly in its general principles, to that of specialization in the training of medical students. I believe that no matter in what special field the inclinations of the trained nurse may lie, no matter toward what special field she may intend to direct her effort, there must be a broad basis of general undergraduate training before special studies are taken up. But I also think that a good training school ought either to be able to supply that later need, or be in close contact with agencies which are in a position to supply the need of special training.

As we all recognize now, one of the very unfortunate directions in the development of our hospitals both in this country and in England, was the severing of the special from the general hospitals. This has brought about all sorts of difficulties and embarrassments. There is no question that most of these independent and special hospitals would do a far larger service to the community if connected with general hospitals than as independent institutions. Consequently here, as in many other directions, we encounter one of the embarrassments in the lack of provision designed for the treatment of special diseases, and thereby furnishing an opportunity for the special training of the nurse. We are trying to meet that need at The Johns Hopkins Hospital with a considerable measure of success. Thus, we have now three important special divisions in the hospital: the Phipps Psychiatric Clinic, the Harriet Lane Home for Invalid Children, and more recently, the Brady Urological Clinic. Of course we need other departments, such as those for eye, ear, throat and skin diseases, etc. The lack of special hospitals in connection with general hospitals is one of the difficulties in furnishing complete and rounded training for nurses. Also a situation of no

little difficulty is created as to what should be done with those who receive their training exclusively in these special hospitals, often small and very inadequately supported institutions. It needs no argument of course that one who has only that narrow training has not the rank, and should not receive the rank of a properly trained nurse. There are all sorts of efforts to bring into connection with a good general training school the schools connected with the smaller hospitals. I have just returned from Saranac Lake, where I attended the opening of the New Trudeau School of Tuberculosis. It is most interesting and complete, and there I learned that an arrangement has been made by which the nurses at the sanitarium are brought into relation with the training school at the Bellevue Hospital in New York.

Of course if all the special hospitals were provided, it is obvious that the training of the nurses in the undergraduate period could not go widely in all these directions. Here again, as in the case of medical students, specialization should follow undergraduate general training.

The public health nurse has become one of the very greatest agents in the advancement of health, both individual and public, in this country. The movement started as a voluntary one and now has become a recognized governmental or municipal undertaking. That is often the best way to begin. As in the case of the tuberculosis nurses in Baltimore, when the need of nurses in connection with the health work of the city had been demonstrated and become a necessity, it was pointed out to the authorities of the city that here was an association doing work which was not a part of a private association, but which belonged to the municipal government. So strong an argument was made that there was no great difficulty about securing an appropriation for the establishment of this department. Here then is a direction which is going to be of increasing importance, namely the opportunities for training nurses in the special directions, the care of mental patients, tuberculous patients, infectious diseases, etc. I refer more especially, however, to their work in social improvement of all sorts and in public health work. I do wish and hope that our training school in connection with The Johns Hopkins Hospital may be in a position to do the great service it could really render with the requisite means at its disposal in forwarding this movement.

These were the two things which I had in mind—a word about certain directions of improvement in the education of nurses, and more particularly, an appeal for an adequate endowment, because after all it is a question of ways and means to broaden and strengthen the educational work of the training school.

I do not propose, members of the graduating class of nurses, nor do I feel any competency to give you any words of advice. In general I am not very

much in favor of those conventional last words of advice to graduates, but I do wish, especially in behalf of the medical staff of the hospital and of the medical school to congratulate you and to express to you our very best wishes and God speed for your future success. In closing I would like to read those very familiar lines of Longfellow on The Lady with the Lamp, because I think the "lady with the lamp" has come today to represent a good deal more than it meant to Longfellow. I refer of course to the familiar poem inspired by the work of Miss Florence Nightingale.

SANTA FILOMENA

Whene'er a noble deed is wrought,
Whene'er is spoken a noble thought,
Our hearts in glad surprise,
To higher levels rise.

The tidal wave of deeper souls
Into our inmost being rolls,
And lifts us unawares
Out of all meaner cares.

Honor to those whose words or deeds
Thus help us in our daily needs,
And by their overflow
Raise us from what is low!

Thus thought I as by night I read
Of the great army of the dead,
The trenches cold and damp,
The starved and frozen camp,—

The wounded from the battle-plain
In dreary hospitals of pain,
The cheerless corridors
The cold and stony floors.

Lo! in that house of misery,
A lady with a lamp I see
Pass through the glimmering gloom,
And flit from room to room.

And slow, as in a dream of bliss,
The speechless sufferer turns to kiss
Her shadow as it falls
Upon the darkening walls.

As if a door in heaven should be
Opened and then closed suddenly
The vision came and went
The light shone and was spent.

On England's annals, through the long
Hereafter of her speech and song,
That light its rays shall cast
From portals of the past.

A Lady with a Lamp shall stand
In the great history of the land,
A noble type of good,
Heroic womanhood.

Nor even shall be wanting here
The palm, the lily and the spear,
The symbols that of yore
Saint Filomena bore.

OPPORTUNITIES FOR THE DEVELOPMENT OF SCIENTIFIC MEDICINE IN CHINA[1]

We have come to China not to impart information to you but to carry some knowledge of China away with us. We shall take away much more information than we shall leave. It is a great privilege and pleasure to meet such a body of men as are here this afternoon. No similar opportunity has come to us in China. And we esteem it a privilege, among other reasons because it gives us an opportunity to say a few words about our work, for which we must have the impetus of the sympathy and cooperation of such men as you.

We have been in the east a little over two months so that the time has about expired when we feel the impulse of the freshly arrived to write a book to present our views of the solution of the problem of the regeneration of China. It does not take a long stay to be impressed with certain conditions and opportunities. We have come to learn how we can best fulfill the great philanthropic purposes of Mr. Rockefeller and his associates in the way of promoting the advances of modern medical education in China.

Modern medicine is very different from the practice of three or four decades ago. Medicine entered the modern era, along with the other sciences, at the time of the revival of learning in the sixteenth and seventeenth centuries. This was the period when the minds of western men began to be opened to new methods of investigation of natural phenomena. Exact observation, experiment and the verification of hypotheses by experience are the characteristics of these methods, which have revolutionized western thought and civilization. The great reform in medicine was initiated in the middle of the sixteenth century, by Vesalius, who first realized the necessity of dissection of the human body to determine its real structure. He was the great pioneer in scientific medicine. The experimental method in medicine was introduced by Harvey, about seventy years later, as it was for science in general by his great contemporary, Galileo, and with the introduction of that method western civilization broke with the past. I venture to say that China has never followed the western nations in this respect. China is still learning and venerating the contents of books as before Vesalius, Harvey and Galileo all Christendom was bound by the doctrines of Aristotle and Galen.

[1] Report of an address delivered to members of the Saturday Club, Shanghai, China, October 30, 1915.

The China Press, Shanghai, 1915, No. 1280, Vol., p. 1 and 7.

It is of fundamental importance that China should come to understand the influence of the experimental method of the verification of hypotheses on the progress of western civilization. It was a new agency put into our hands for the advance of science and of civilization. In this regard China has never broken with the past. She stands where we stood before the new lever of progress was discovered. This consideration appears to me fundamental to an understanding of the educational situation in China.

I shall not attempt to sketch here the history of modern medical science. But I wish to say that the next great advance was made by Morgagni, in the latter part of the eighteenth century, when he recognized the importance of postmortem examinations by the discovery of the seats and causes of the symptoms of disease. Early in the nineteenth century pathological anatomy became the basis for the scientific study of disease. China cannot have modern scientific medicine, until it is understood here that dissection and autopsy are of vital necessity in medical education and progress. I feel sure that the realization will come, and the problem be met. The Chinese seem to be a practical and adaptable people, and will cease to merit the designation of the "Unchanging Chinese."

The way, then, by which modern medicine has become so different from that of the past is by this scientific method of inquiry, and by the introduction of instruments of precision for diagnosis and experiment. These followed some forty years ago the revolutionary discoveries of the causes of the great epidemic scourges of mankind, the infectious diseases. First applied to surgery these discoveries led to the great advance marked by the introduction of antiseptic and aseptic methods of operation. Applied to hygiene there resulted the great victories of preventive medicine over typhoid, cholera, plague, diphtheria, yellow fever, and other diseases. Applied to therapeutics it led to such wonderful control over the course of disease as that exemplified by the antitoxin treatment of diphtheria and by the use, in cerebrospinal meningitis, of the serum which we owe to my distinguished colleague, Dr. Flexner.

The whole world began to realize that medicine had the power to benefit mankind in a hitherto undreamed of way. Formerly medicine had been stepmothered by philanthropy, but now contributions began to come in for schools, and hospitals and institutes for research. The recognition of this great power that modern medicine possesses is what gives its great significance to this effort for China.

We do not consider that we have undertaken an entirely new endeavor in China. The missionary work that has already been done furnishes a foundation for our efforts. Missions were greatly advanced by the introduction of western education as a part of their work. They were still farther advanced

by the entrance of the medical missionary into the field. The work that these men have done is beyond all praise. I would like to pay the highest tribute to those men who felt the impulse to treat men's bodies as well as their souls. They came primarily not for medical teaching, but as the work grew they felt the necessity of training men to help them. So the medical schools as they now exist have gradually grown up to supply this need. Considering the insufficient staffs and meager equipment it is wonderful what they have done. Much of the work has developed around strong personalities. One cannot help being stirred and inspired by some of them. It is an education in itself to come under the influence of such men.

But these men would be the first to realize that they are merely meeting the immediate needs of the day. They would be the first to welcome the coming of others to build on the foundations that they have laid. We have come to China with the hope of establishing two or three medical schools as good as those in western countries. This is not a revolution in medical education, for there does exist here the recognition, and in part the realization of this ideal. We saw this morning the work of the German Medical School, where young men, with such facilities and equipment as they possessed, were engaged in training students in modern medicine, and stimulating them to research.

It is the purpose of Mr. Rockefeller and the Foundation to connect this work of the China Medical Board with the missionary effort. I doubt if a similar opportunity has ever come to the missions before. If they connect themselves with this larger endeavor how vastly greater will their influence and the beneficial scope and results of their work become. I am sure they will rise to the opportunity with its great promise for the future.

Our purpose is not to impose something foreign on the Chinese, but to train up a truly Chinese medical profession. The sooner they can come into their own, the sooner they can begin the creation of a medical literature that is worth while, the better we shall feel about our work. The ultimate aim is to put the work entirely into the hands of the Chinese themselves, and to be able, with confidence in their future, to withdraw from the field. The rapidity with which they accept scientific medicine as their own, and the rapidity with which our importance in the field diminishes and their importance increases will be the measure of success.

It need not be said that this is a purely philanthropic endeavor, part of the great organization for philanthropy that Mr. Rockefeller has built up. You know how he has established the Rockefeller Institute of which Dr. Flexner is the distinguished head. You know how it has grown, and become a source of valuable contributions to medical science, and an ornament to American medicine. Mr. Rockefeller feels that the saving of untold thousands of lives

effected through discoveries made in that institute is a reward far surpassing any amount of money that has been or could be invested in it. You know also of the International Health Commission, the gift to The Johns Hopkins, and to the General Education Board. We were fortunate to capture Dr. Buttrick to give his wisdom, personality and wonderful executive ability to the work of the China Medical Board. It was great good fortune for us here that we were able to get Mr. Greene as Resident Director of the work in China, a man with whose work in China some of you are already acquainted. And while I am speaking so personally I must mention our youngest member, Dr. Gates, who is the son of the man who has had the great position and responsibility as advisor of the way in which Mr. Rockefeller's philanthropies can be best directed, a man of large vision of the possibilities of science conjoined with philanthropic endeavor.

In regard to our policy, I think we can do better for China by concentrating on a few centers the funds which are small in comparison to the aggregate need. Modern medicine means far more than the care of the sick and wounded, important as that is. It touches all phases of society. It has a broad and liberalizing effect on education. No wonder all the workers in hygiene and social reform have grasped in a peculiar way the significance of modern medicine for the uplift of society and the progress of civilization. Our great modern cities, for instance, could not exist without the help of modern medical science. You could not live here in Shanghai without the knowledge and power that has been placed in Dr. Stanley's hands to stay pestilence and to promote conditions of healthy living. The indirect benefits to be expected from the introduction of the best medical education and of the science and art of modern medicine into China are far reaching, relating as they do, to other departments of education and knowledge and to fundamental problems of industry and of society.

SPIRIT OF EXPERIMENTAL SCIENCE IN EDUCATION AND OPPORTUNITIES FOR SCIENTIFIC MEDICINE AND SERVICE IN CHINA[1]

My Friends, Students of Yale in China.—I wish I could tell you in your native language how much pleasure it has given Dr. Gates and myself as representatives of Yale to come here before the other members of the commission to see with our own eyes, and hear with our own ears about the work which is being done. I have looked forward to this visit with eagerness, for while I have read about the work and have long been interested in it, I never dreamed that this opportunity would come to me of seeing and hearing about it on the spot.

I have already been stirred; for since coming to China no more inspiring occasion has come to us than this opportunity to see evidence of the transplantation of the spirit of Yale into the heart of China. I have referred in another place to the spirit of Yale, but with some restraint, for I have been subjected to some good natured criticism by my envious colleagues for a certain conceit in the claim of Yale to virtues denied to other colleges. But here I feel that I can speak with greater freedom. We do have in New Haven a "Spirit of Yale" which stands for equality and democracy and ideals for character building that must make a strong appeal to you in China. We do not consider that an education comes only from books and lectures, but that the best and a very essential part comes also from friendships and contacts with one's fellows. If these do not build strong character and increase power we feel at Yale that the system is a failure. I got something from my classmates that became a real part of me, and that has always had an influence in my life. I hope and believe that that spirit and influence are here in "Yale in China." Then, too, there is something imparted at Yale that lends vim and vigor to life; that aims at getting the best out of life, of attaining its best ends; a determination to find and achieve the purpose of life. I am glad of this opportunity of indicating these things to you in order to help you to realize this same spirit and these aims.

And to you, young men of the Faculty, for you are young from my point of view: I think that your life is a most enviable one. No sympathy from

[1] Report of an address delivered to the students of Yale at the Sunday Morning Chapel Service, Changsha, Hunan, China, October 17, 1915. Copy furnished by Dr. Frederick T. Gates.

Not previously published.

me, only envy; for you have here a larger opportunity for service and of gaining the real mental, moral and spiritual satisfactions of life than most of you would be likely to find in America. I am going back with a message to the young men at Hopkins. Why do so many eke out their lives amidst the unsatisfactory environment and the meager opportunities that come to most of them? If they have intellectual curiosity, something of the spirit of adventure, desire to advance medical knowledge, desire for beneficent service, where can any opportunity make a stronger appeal than that here in China today, especially in the development of modern medical science and practice in China? You must feel the enthusiasm and inspiration of the opportunity, and be eager to be provided with the staff and the equipment to meet the opportunity you see before you.

This mission of Yale in China is primarily educational, and educational in the best sense of the word. The future of the race depends upon the acquisition of knowledge and wisdom, on learning how to adjust ourselves to our environment, how to conduct our lives for the greatest usefulness, how to be of the greatest service to our fellow-men and to our country. To teach these things in the largest sense is what a true educational mission should mean to China.

Dr. Hume has suggested that I say a few words of the mission of science in education. I can touch only on a few aspects of the subject. Modern science differs from the great body of ancient knowledge by the attitude of mind and by the method of inquiry into the phenomena of nature. Men thought once that truth could be attained by the use of the human intellect alone. The great body of knowledge in times past was obtained by just thinking about things. Our minds are not better than the ancients'. The two great bodies of ancient knowledge are the Greek and the Chinese philosophy. These two stand as monuments of acute and penetrative thought. It took men long centuries to appreciate that they could not penetrate deeply into the nature of things merely by reading and thinking about them. It is singular how little appreciation existed in ancient times of the necessity of testing hypotheses and theories by accurate observation and experiment. The new method of scientific inquiry came in about the beginning of the seventeenth century when Gilbert in England, and Galileo, and Sir Francis Bacon demonstrated the true method of studying the phenomena of nature and of gaining control over them. The modern era of western science dates from this period. This great realization was lacking in Greek and Chinese thought.

As a result there has occurred a revolution in western methods and thought and civilization that has not taken place in China. Before the introduction of the experimental method of scientific inquiry in the seventeenth century

the Chinese would have come to us to be our school masters and teachers in philosophy, science and art. That method has allowed us to outstrip you of China in many things and to acquire the lever that has opened the secrets of nature to the West to a degree unknown in this land.

That method does not permit us to accept as true in natural science what has not been tested by experiment and observation under carefully controlled conditions. The introduction of this spirit and method of science is the great need in China today. You have trained yourselves for generations by reading and by being told about things and have an unequaled and almost uncanny power of acquiring learning in that way. What you need in educational methods is in the first place the power of making and recording accurate observations, but that alone is not enough. The scientific mind is keenly alive to inquiry into the how and why of things. I am not sure that the Chinese mind craves explanations of this character; if not, it is a desire that must be cultivated by education.

Knowledge that is acquired merely by reading and being told about things does not enter into us as a real living force, and does not give the power to utilize that knowledge. You need the power of independent observation, to make experiments and draw inferences, to see with your own eyes, and touch with your own hands, and hear with your own ears. You need to go over for yourselves the processes by which natural knowledge was first acquired.

This point of view I believe to be of fundamental importance for education in China. I confess I have been shocked at the lack of appreciation of this method of science, which consists in seeing and doing things at first hand. That is the kind of knowledge that gives power and should bring some measure of wisdom with it. That is the instrument that has given man mastery over nature, that has been the lever of progress in the nineteenth century, and that is the great need of China in education.

In every field of human activity progress has been made by this method, but nowhere have greater benefits or greater victories resulted than in the field of medicine, as may be illustrated by the control over pestilential diseases gained through the application of the new knowledge concerning the origin, nature and mode of spread of infectious diseases.

We are far short of this goal, but much has been gained. America has given one of the greatest gifts in the boon of anaesthesia. We who realize what it would mean for China to have this new knowledge introduced and applied feel that there is no opportunity for doing good comparable to this of coming here to promote the spread of this knowledge. Dr. Hume and Dr. Yen have felt the call and are doing what they can. But they lack men and equipment. If we can do anything to promote their work we feel that it would be a great opportunity for you and a great privilege for us.

Speaking to you as young men I would like to emphasize two or three things. First, you should all know something of the structure and functions of the human body, and how the more important diseases are spread, especially tuberculosis, malaria, typhoid, dysentery, schistosomiasis, etc. Then it is important for you to know that you can strengthen your powers of resistance to the invisible causes of disease by proper care of your health, so that the germs may fall on stony ground. Especially you should realize the value of fresh air, of living and sleeping in the open.

I have spoken of the spirit and methods of modern science. It has also an important influence on character. It inculcates a love of truth, of accuracy and precision. The time will come when the spirit of scientific inquiry will arise among you. Your scientific men will have a love and a joy in the search for truth. Lessing said that joy comes in the search of truth, not in the acquiring of it. I believe that high ideals of character are imparted by the true knowledge and spirit of science.

The other great fruit of the scientific spirit is the zeal for service. The true scientist has a love for truth and a desire to know about things for themselves, but he always rejoices when his knowledge finds useful application for the benefit of mankind. Who could have foreseen any relationship between the discovery of the aniline dyes in the fifties, and the application a quarter of a century later of these dyes for the demonstration of the tubercle bacillus and the resulting crusades against tuberculosis? Yet that is a striking example of the way in which new knowledge does find application. And such possibilities of usefulness engender in the man of science the desire to be of service to mankind.

Character, the spirit of truth, and the spirit of service are the Christian virtues engendered by science. There is no real difference between the scientific spirit and the Christian spirit. For the spirit of Christianity has as its foundation the upbuilding of character, the spirit of truth, and the desire to be of service.

I congratulate you on your opportunities here and wish you all success. I hope some of you may have stirred in you the spirit of science which we are trying to introduce into China.

MEDICINE IN THE ORIENT[1]

I have been inflicted upon many audiences since my return from the Orient, but my experiences covered such a wide and varied field I am not aware that I have repeated myself to any great extent, and I am quite sure I have not covered the whole territory. In the selection of my title this evening it was my intention merely to speak of such aspects of the subject as might occur to me. By the Orient we usually mean India, Egypt, Babylonia, China and Japan, but what I shall have to say will relate to China and Japan.

I shall speak tonight of native Chinese medicine, and later about the more recent developments of Western medicine in China and Japan. If we can trust Chinese annals and their own historians, their civilization is the oldest in existence, and their medicine is coincident with its development. One of their medical works in existence today, attributed to one of the emperors of China, dates from about 2700 B. C. Through the kindness of Dr. Brown I have with me some pictures from that and other Chinese medical works—one of which is supposed to be the picture of the author of that work, Shan Nung, spoken of in China as the father of medicine. I have also a picture of Wong Tai, the author of a standard work on medicine, dating back to 2697 B. C.; and various other illustrations, one showing the sources of some of their remedies, e. g., stalactites used in the treatment of syphilis; another illustrating the uses of the skin of an elephant; others illustrating surgical diseases as a carbuncle on the thigh, scrofulous glands of the neck, an ulcer behind the ear, etc.; and also an illustration from the works of Wa To, their greatest surgeon, who lived about 200 years A. D. and the only one who seems to have done any capital operations. The last one illustrates an operation for necrosis of the elbow, upon a great Chinese general, Wau Tai, who is shown sitting with great composure in conversation with someone on the other side of the table.

The ancient Chinese medicine has continued practically to be the basis of their accepted views of the nature and treatment of disease up to the present day. I can imagine nothing comparable to the unchanged and unchanging character of their medical ideas. Their views of anatomy, of physiology and of the nature of disease are to us fantastic and absurd. It

[1] Report of an address delivered before the Book and Journal Club, Baltimore, March 22, 1916.

Bull. Med. & Chir. Fac. Maryland, Balt., 1915-16, VIII, 196-205.

is stated that they often dissected the human body, but their anatomy gives no evidence of such dissection. We were told in an address by a Chinese scholar at an elaborate dinner in Changsha that during the Han Dynasty, from 200 B. C. until 200 A. D., certain Chinese doctors dissected the human body; but this has left no influence on their accepted ideas of anatomy. They have a general pathology, which reminds one a little of the pathology of Hippocrates and Galen. They recognize twelve principal organs and twelve principal cavities of the body. *Five* is their sacred number—there are five elements, air, water, fire, wood and metal. They have no real idea of the vascular system, and though they use the word circulation they are not to be credited with any clear understanding of the circulation of the blood. The dominating idea in their conception of anatomy is that two elements, masculine and feminine, called the Yan and the Yin, preside over the various organs of the body. All that is active, vigorous, solid, and hot, is represented by the masculine or Yan element; all that is cold, moist and fluid, by the Yin or feminine element: disease is due to a large extent, to disturbances in the mixture of these two elements. Each organ of the body is related to a color, a taste, a season, and a time of the day; every organ has a parent, friends and enemies. The heart which they regard the central organ of the body, is the son of the liver, and the stomach is the son of the heart. The friend of the heart is the spleen and its enemy is the kidney; its color is red and its season is summer. It receives at midday; and if a person is hit in the chest at midday it is very dangerous. Boxers in China are supposed to know at what hours of the day the different organs receive, and to strike their blows accordingly.

The Chinese have no accurate idea of the vascular system. They believe that there are channels leading from one organ to another, that the larynx opens into the heart, the spinal canal into the intestines, the vas deferens from the kidney. What they call the circulation is the passage of "vital spirits" through these channels. This extraordinarily bizarre conception of anatomy is still held by the native Chinese doctors, and represented the anatomy of the Japanese who received their medical training in China until they were trained in Western scientific medicine.

The great obstacle today to any development of their anatomical knowledge, and one which I fear will continue to be a very considerable obstacle, is the difficulty of making dissections. The Chinese religion is opposed to dissection. Ancestral worship really dominates their lives. They believe that if the body is mutilated it will so appear in the next world; and therefore if a surgeon performs an operation—an amputation, for example—he is obliged to give the patient the removed member, which he carries away with him. The eye, if this is removed, must be given back to him—or a hand

or an arm—and is carefully preserved, so that in the next world it can be restored to him, or otherwise he will not be united with his ancestors. The present government, however, has issued an edict legalizing anatomical dissections and postmortem examinations, and the bodies of criminals are available for such purposes. But dissections at present is carried out only to a very limited extent. It began I believe in Peking, and has further advanced into Shanghai, but elsewhere there is very little dissection of the human body. Except in Shanghai I could learn of no postmortems.

Their methods of diagnosis are in some ways more enlightened than their anatomical and physiological notions. They base their diagnosis upon the refined examination of the pulse, and have a very large literature containing much detailed description as to where and how the pulse should be examined—behind the occiput, behind the ear, at the temples, at two or three places on the arms and at different positions in the abdomen and in the lower extremities. The pulse is palpated by the index, the middle and ring fingers, and must be felt on the top, on each side on the outside and inside of the finger. It must be felt with light pressure, then with a little firmer pressure, and then with still firmer pressure; and each finger, depending on where the pulse is palpated, will give information concerning different organs of the body. Sometimes one hour or two hours are occupied in such careful study of the pulse. The Chinese doctors do not ask questions, and have little or no knowledge of the anamnesis of the patient. To some extent they examine the tongue, the facies and the eyes. The different internal organs correspond to certain portions of the exterior of the body. Thus information about the heart is obtained from examining the tongue; of the lungs by a careful examination of the nostrils, and so on.

They have in their medical works discriptions of disease by which they identify it. Smallpox is said to be very well described. In the West we have no accurate information of its appearance before the sixth century, but it is described in the Chinese annals as existing some three hundred years before Christ, though it was not until the sixth century that it began to be prevalent. A great deal of interest attaches of course to the question as to whether syphilis existed in China in the pre-Columbian period. Fujikawa, from whose works I obtained most of my information about Japanese medicine, gives a definite statement as to the appearance of syphilis in Japan in the twelfth century. I followed up this subject a little further and found that Scheube states that his description is not necessarily applicable to syphilis. It is quite certain, however, that syphilis existed in China in the first half of the sixteenth century and that it appeared in Japan about the middle of that century; but there is no authentic evidence that it existed in China or Japan before that time. In other words we cannot furnish proof

that syphilis existed anywhere in the world in pre-Columbian days. In the early part of the sixteenth century Portuguese traders reached Southern China with their ships, and came to Japan about the middle of that century, and thus there was an opportunity for the introduction of syphilis from Europe into the Orient.

A great, distinctive feature of Chinese medicine is its materia medica. Their anatomy, physiology and methods of diagnosis all seem to us highly fantastic; but the Chinese surpass the rest of the world in their empirical materia medica. They have a voluminous medical literature on this subject—the single works in many volumes, nearly fifty volumes from one author—which is very valuable, though it cannot be said that they have made any progress since their early days. But there are definite reasons for such lack of advance. A native doctor, for instance, is reluctant to accept a patient who is in danger of dying for if the patient does die, and has influential friends, there may be a judicial procedure, and the doctor must demonstrate that he treated his patient according to the rules of his art, which are laid down in their medical books; and if he has not made his diagnosis according to these books, or if on the basis of that diagnosis he has not given the remedies prescribed in the books, he is condemned, imprisoned, and his life even may be forfeited. Can you imagine anything more calculated to keep medicine within its old barriers? They also have an elaborate and very curious literature on legal medicine, and many extraordinary judicial procedures. They have a series of tests: for instance the question of blood relationship may be determined by taking a drop of blood from each of two individuals and letting them fall into a basin of water; if the drops run together the persons are related; if they do not run together they are not related. Or perhaps an old skeleton is found and a person whose father has been killed may wish to claim it; if a drop of his blood dropped on the skeleton sinks into the bone it is decided to be the skeleton of his father; if the blood does not sink in, it is not the skeleton of any of his relations.

The leading Chinese work on pharmacology contains something like 200 drugs, from all three kingdoms, though principally from the animal kingdom, many of which are in use in Western medicine today. Rhubarb came from China into European practice; the Chinese use mercury in the treatment of syphilis, both internally and as a vapor by inhalation; also sodium sulphate and copper sulphate. Indeed, most of the remedies in the Occident have existed in Chinese materia medica since the earliest time.

We were much interested in the shops and booths of the Chinese doctors in the public squares of Nanking, where we had gone to see the Confucian temple. There were dried roots, stems and leaves, snake skins, toad skins and bones of animals—particularly tiger bones, which are ground up and

used as a tonic. They have an old distinctive procedure in the use of moxa as a cautery—the leaves and stems of the *artemisia moxa* are ground up and made into little conical pastilles which are fired and burn the skin; in the dispensaries nearly all the Chinese I saw had scars where moxa had been applied. They also use the actual cautery. But peculiarly distinctive of the Chinese method of treatment is their needling—acupuncture—which is used as a counter-irritant. It is done on all parts of the body, and the missionaries tell distressing stories of the effects of these punctures in certain locations, for even the eye is needled if a person complains of a pain in that organ.

Anyone may practise medicine in China. In the early days there were schools of medicine and there seems to have been a certain training; but today, so far as I am aware, there are no native schools of medicine. There are a few native hospitals, however. I heard of two in Canton, and Dr. Brown tells me that there is one in Peking where the native method of treatment is employed. Medicine is a profession which is handed down from father to son, and those doctors are most highly esteemed who have a long line of medical ancestors. They acquire their training by reading their old medical books, which are committed to memory through remarkable capacity which the Chinese have for learning things by rote. Apparently with the greatest ease they commit to memory page after page, and indeed whole books, and this is all the training they acquire. Medical practitioners are extremely numerous in China. Their social standing, with the exception of a small group in Peking in early days constituting the College of Examining Physicians for the Court, is low, and often they are poorly educated, though some among them are cultivated, refined and, according to the Chinese ideas, educated men and masters of their medical literature.

In the Chinese town and cities the signs upon the doctors' offices are very numerous, and often in connection with them are testimonials put up by grateful patients, sometimes with elaborate statements as to the cures they have received. We had an interesting experience in Canton, where while being carried through the streets in our sedan chairs we came upon a curious procession, which we were told by our coolie was a doctor's procession—a not uncommon occurrence. It was a procession ostensibly arranged by a grateful patient who had been cured by his doctor. In the lead was a picture of the doctor with a wreath about it, borne along on an elaborate frame; then came music; then very beautiful Chinese calligraphy which of course we could not read, giving a description of the symptoms from which the patient had suffered and the wonderful cure that had been effected; and then followed the presents which were to be given to the doctor. It was the public expression of the gratitude of a patient for the success of his treatment—

a public evidence of his cure. Can you imagine anything in the way of an advertisement that could exceed this novel method—which I may add was extremely artistic and very fascinating to us.

The general impression of the practice of native Chinese medicine is very unfavorable. But on the other hand we have a great deal of evidence that they possess some remarkable remedies and cure some of their patients—though I cannot say how many. An English doctor with whom I crossed on the steamer who lives in Malacca, where there are many Chinese, expressed the opinion that they have some very valuable therapeutic procedures that are well worth investigating. They have a remedy, he said, which relieves dropsy from renal disease; he cited the case of a patient, a wealthy and influential Chinese whom he had regarded as very ill from Bright's disease. He told him that he did not think that he could do anything more for him and asked him if he had any objection to calling in one of the native doctors. This was done, and two weeks later his patient was walking about apparently cured. It was very mystifying; this English doctor is one of the relatively few who are of the opinion that some of the remedies of the better class native Chinese doctors may be really valuable.

The Chinese in their attitude toward the outer world, are much the same mentally as they were in the middle ages and even before. They have never advanced into the modern period, which may be said to begin about the year 1000, after Galileo and Kepler and the introduction of experimental science, when it became clear that speculations, hypotheses and theories were of little value unless they could be put to experimental test; that the most ingenious theories were otherwise of no avail. What could be more wonderful than the doctrines of the old Ionian philosophers! but it never seemed to occur to the Greeks to put them to the test of experimentation. The Chinese accepted and have held these doctrines, some of which can easily enough be tested. They are in contrast in this respect with the Japanese, who were not satisfied merely with taking over Chinese ideas but who showed a spirit of inquiry even before the introduction of Western medicine into the Orient.

For centuries the Chinese have done no major surgical operations. They drain ulcers, incise superficial abscesses, and have a rough sort of dressing for fractures. Castration of course is done on a considerable scale on account of the necessity of supplying a large number of enuchs. Foot-binding is in a sense related to surgery. The explanation of the origin of this most ancient of customs is not known. One very common idea is that it was done to keep the women at home. But whatever the origin, Chinese men have become accustomed to it as a part of the attractions of women, and it is a general impression, I believe, that young Chinese girls are not marriageable if they have natural feet. This idea will be overcome in time but at present

it is one of the great obstacles to all attempts to do away altogether with the binding of the feet. The Manchus of the ruling dynasty have never bound their feet, and are readily distinguished by this fact; but it is a custom that is universal in all classes. It is done at a very early age, when the child is three or four years old; the toes are bound up under the sole of the foot and the heel is drawn up, so that there is only a little stump left to walk upon. It is a most painful process, and the distressing cries of the children, day and night, who are being subjected to its practice, are familiar sounds in China. Every effort is being made at present on the part of the educated Chinese to do away with this ancient custom. But we saw plenty of it everywhere. In Peking it was very obvious, though we also saw many Chinese girls there with unbound feet. In the province of Shantung—perhaps the most densely populated and one of the most conservative provinces of China, we are told that very little impression had been made by the effort to do away with binding feet; but in Central China, in Kiang Su, Shanghai, Nanking and Hongkong, a region which is very enlightened a considerable impression has been made. The missionaries of course are exerting great influence in this regard, and are not admitting girls with bound feet into their schools. The process of unbinding the feet is extremely painful, and cannot be done after a certain age. In one of the women's hospitals in Peking which we went through, Dr. Manderson and Dr. Heath, the two doctors in charge, were anxious to show us the ward where they were gradually removing the bandages from the bound feet of the young girls. We were allowed to go into the ward, but not a single girl would let us look at her feet, in spite of the efforts of the doctors, because of the feeling in regard to being inspected by men.

Western medicine first came into China with the medical missionaries. The first missionaries to China were the Jesuit Fathers in the sixteenth century. One of their number—Father Ritchie—is one of the most interesting characters in the early history of missionary effort. Under his influence Christianity made great headway in China and was favored even by the official classes. He held the view that many Chinese customs could be retained as not incompatible with Christianity—such as Confucianism and ancestral worship—which did not amount to a religion. It is very interesting to consider the progress of Christianity in China under the views of the Jesuit Fathers and the great obstacles which it has encountered since. The question was for a long time in great dispute and forms a chapter in all Roman Catholic ecclesiastical histories; but the decision was finally against Father Ritchie's views.

Many of the early missionaries had a medical training. Morrison, the great pioneer, who came to China over a hundred years ago, had studied

medicine. Also Peter Parker from Yale. He is one of the great characters in China. Those men have all done a wonderful work. Of course they encountered opposition—which has not altogether died out, though it has been overcome to such an extent that it is very little in evidence in such a trip as ours. The history of missionary effort in China is extremely interesting and could be made the theme of a special topic. The stories of these men are full of inspiration. They are leading such devoted lives and are doing such an immense amount of good for the relief of suffering that one cannot help having the deepest respect and admiration for them and for their work. They have gone primarily in a missionary spirit and not as physicians,—they have gone with the purpose to convert the Chinese, to save their souls, and have regarded their medical work as an instrument put in their hands to reach the souls of the Chinese through their bodies. But in carrying out their primary motive they have at the same time cultivated and practised Western methods in medicine and have demonstrated their superiority to such a large number of the Chinese that Western medicine is taking the field wherever it is introduced, as it is in the large centers. There the hospitals and the out-patient departments are crowded. Everywhere is there need for larger staffs, women doctors as well as men; everywhere especially the need for more nurses. With increased facilities they could double, they could quadruple, the good they are doing. Everywhere they are overworked, and of course cannot do justice to their task with this tremendous demand upon them.

Their work is largely surgical. We are told that the Chinese are not greatly impressed with the superiority of our treatment of internal disease over that obtained by their own drugs. They employ their native doctors when anything is the matter with their insides, but for a surgical operation they seek the Western doctor; so that in a sense perhaps Western surgery only has had this great triumph in China. One reason for the great success of Western surgery rather than of internal medicine is that the surgical case seems more urgent, and the opportunities for demonstrating the superiority of its methods are more dramatic, to say the least, than the cure of internal diseases with drugs.

The great need in China of course is the training of Chinese students in Western medicine. It is impossible to conceive that in a great country of 400,000,000 inhabitants American and European physicians could begin to meet its medical needs. A few Chinese students have been trained here and in Europe, and two or three of them whom we met were of superior character, but none I think are likely to be real ones. A much larger number receive their training in Japan, for it is easier and much cheaper for them to go to Japan, and Japan today is abreast with America and Europe in medical

science and practice. The schools of Japan, however, are of different grades, and the majority of the Chinese who have gone there for their medical education have attended the relatively inferior medical schools. There are only a few Chinese students in the medical schools connected with the Imperial universities and but two in the splendid school in Tokio. On the whole the Chinese doctor trained in Japan did not impress us very favorably.

There are also those who are trained at home in the medical schools in China. These schools are of different sorts; there are medical missionary schools, government schools and some private schools. The missionary schools on the whole are the best; but there is nothing in China which really meets the need. Many of the schools are almost wholly a one man school; a good doctor in charge of the hospital takes a group of Chinese students for four or five years, giving them perhaps a diploma at the end of this time, in some instances merely a certificate, and occasionally a degree. What is needed is the establishment of two or three first-class medical schools where the Chinese can secure as good an education as in the best schools of this country and Europe. We are told, and I think it is undoubtedly true, that it is important that they get their training in their own country; that if they go abroad they get largely out of touch with the problems of their country and even with their language, and that those who go abroad accomplish little when they return. As you perhaps know, the Rockefeller Foundation through the China Medical Board expects to establish two such colleges. For one it will take over the existing Union Medical College in Peking, remodel and reorganize it, and get as good men for their teaching as can be secured. The second of the two schools will be in Shanghai. This is felt to be the best course at present to reach the ultimate goal of training up a group of Chinese physicians who will be able to carry on the work themselves, as the Japanese have done in Japan in an incredibly short time.

I will say just a word regarding disease as we observed it in China. Tuberculosis is enormously common: it is seen everywhere; there is more tuberculosis in both the medical and surgical wards of the hospitals and the out-patient departments than any other disease. Venereal disease and syphilis are very prevalent. It has long been believed that the so-called parasyphilitic infections were unknown in China, but this is entirely an error. That they have locomotor ataxia, paresis and progressive paralysis has been clearly demonstrated by Dr. Woods, who has worked with Dr. Spiller in Philadelphia: it needs only a trained neurologist to discover the existence of these diseases in China. It has been stated also that they have very little aneurism—which is surprising on account of the amount of work done by the human machine in China, where it is cheaper to feed the human machine with rice than to lighten its labor. I do not know what would happen if machinery were intro-

duced into China: it would probably disrupt the whole nation. Stricture of the urethra is said to be very uncommon, but this again I think can be questioned. Smallpox is very prevalent. Curiously enough scarlet fever was unknown there until about ten years ago. Dr. Stanley the health officer in Shanghai told us that it came in with the railroads. It is now increasing in amount, though it has never prevailed as an epidemic. They have a number of curious diseases, of course, that we are not familiar with. One of the physicians is making some very interesting studies of the sand-fly fever, which is extremely common in northern China in May, June and July. Kala azar exists in different sections. Surgeons are removing enlarged spleens all over China, just as we cut for adenoids or appendicitis. I do not think they know they are putting the patient to death. Flukes are very common in China. There are areas in some villages where from ten to thirty-five persons are infected; it is dangerous to bathe, for even the water in the bathtub may be infected. The Chinese have infantile paralysis, but this is not prevalent: I think that not more than a dozen cases have been observed, but of course there is the possibility of its spreading.

I will say a further word about Dr. Stanley's work in Shanghai, where he has one of the best health departments I have ever visited. He himself is a remarkable man; he has a well trained staff, and the laboratory is making vaccines and serums. They are great believers in autogenous vaccines, and send out cultures from all sorts of infections, and no small part of the work of Dr. Moore, who is a well-known bacteriologist, consists in making up vaccines from cultures which have been sent by various doctors.

MEDICAL HISTORY

MISCELLANEOUS

PATHOLOGY IN ITS RELATIONS TO GENERAL BIOLOGY[1]

I esteem it a privilege to assist at the formal opening of this biological laboratory and to be able to extend to this university, and to this city, congratulations for the possession of a laboratory so admirably constructed and equipped, and inaugurated with the assurance of an activity so fruitful and well directed. The existence in this place of such a laboratory is not a matter of local pride alone. It may safely be predicted that its influence will be felt throughout this country, and indeed wherever interest in the biological sciences is found.

With such opportunities as here exist, we may feel assured that this country will increase and expand the honorable reputation already gained by its contributions to biological knowledge.

Biology in its widest significance is the study of life in all its forms and activities, both normal and abnormal. No branch of human knowledge can exceed this in interest and importance; none has made greater advances during this century of scientific progress; none has achieved greater triumphs for human welfare; none has influenced more profoundly modern philosophical thought.

I am here to say a few words concerning one department of biology, namely, pathology, particularly in its relations to general biology.

Pathology is the study of life in its abnormal forms and activities. The relations of pathology to practical medicine are necessarily so essential and intimate, the broader conception of this science as a part of biology is in danger of being lost from view. I deem it, however, important for the scientific status and advancement of pathology to keep in mind and to emphasize its relations to general biology, not less than those to practical medicine.

In so doing, it is not intended to detract in any degree from the practical value of pathology and its applications to the diagnosis and treatment of disease. When we consider that pathology embraces the investigation of the causes of disease, of the anatomical changes produced by disease in the organs and tissues of the body, and of the alterations in function resulting from disease, it is plain that pathology must constitute the scientific basis of practical medicine. This is not the less true because the

[1] An address delivered at the Formal Opening of the Biological Laboratory of the University of Toronto, Toronto, Canada, December 20, 1889.

Johns Hopkins Hosp. Bull., Balt., 1889-90, I, 25-27.

prevention and cure of disease have not kept pace with the advances in our knowledge of the nature and causes of disease, and of necessity can not do so. Preventive and curative medicine, however, is constantly making beneficent application of pathological discoveries, and the most intelligent and efficient management of disease is becoming more and more that which is founded upon the most accurate knowledge of its nature and causes.

Inasmuch as the general public naturally interests itself but little in any side of medicine other than the treatment of disease, there is not sufficient general appreciation of the immense progress in the science and art of medicine of today as contrasted with that of a half century ago. The history of medicine is in large part the history of schools of doctrine. Stately superstructures of sweeping generalizations and attempted explanations were erected only to be overthrown because it was impossible to build upon a firm foundation of facts. Today it is our conviction that these fundamental facts can be discovered in no other way than by observation and experiment. The adoption of this, the only scientific method of investigation, has, with the aid of modern instruments and devices, not only greatly enriched medical science, but it has overthrown the era in which, among scientific physicians, exclusive schools of doctrine can prevail. The scientific physician no more than the scientific chemist, can yield adherence to any exclusive dogma. To the one as to the other no way which leads to truth is debarred.

By way of illustration of the achievements of modern pathology, permit me to contrast for a moment with the imperfect, meager, and confusing information of former times, the fulness of our present knowledge concerning that disease, which of all diseases is the greatest scourge of the human race. Tuberculosis causes the death of not less than one-seventh, and, in some form or other and at some period, affects probably one-third of mankind. But a few years ago, not only was the specific cause of tuberculosis unknown, but there was no general appreciation of the fundamental fact that this is one of the infectious diseases. The knowledge of the frequency and wide distribution of tuberculous disease in other parts of the body than in the lungs is an acquisition of modern pathology. The pathological anatomy of tuberculosis, which not long ago was one of the most confusing chapters in pathology, has been made clear. The unity of all the processes now known to be tuberculous, can be established on an anatomical as well as on an etiological basis. The greatest addition to our knowledge of tuberculosis, and in fact one of the greatest achievements of modern science, is the discovery of the specific living germ which causes tuberculosis. We are now enabled to study both within and without the body, the form and

the properties of this germ, the conditions which are favorable and those which are hostile to its preservation and development. Who can doubt that all this increased knowledge of the most devastating of maladies is destined to help in prevention and treatment? Sanitarians convinced of the preventability of tuberculosis have already begun the warfare against its spread.

If one seeks an illustration of immediate practical results of the modern investigations of the living germs which cause disease, let him turn his attention to the revolution thereby wrought in surgical procedures. The possibility which is now in the hands of the surgeon of keeping wounds free from all external infection, is a boon to humanity not less than the introduction of vaccination.

It would be pleasant to follow still further the practical benefits resulting from pathological discoveries, but it is not my intention on this occasion to dwell upon the application of pathology to practical medicine. I have said enough to remove any misapprehension as to my belief that pathology should be made to serve the ultimate aim of medical education, the prevention and cure of disease. The science must ever hold a foremost place in any proper scheme of medical education.

This occasion is an appropriate one to emphasize especially those scientific aspects of pathology which give it an important position among the biological sciences.

In the first place I claim that pathology as a science, quite independently of any practical or useful applications whatever, is as legitimate and worthy an object of pursuit as any of the natural sciences. In and for itself alone it deserves to be studied. Its methods are those of observation and experiment as in other biological sciences. Its subject matter is any living thing which deviates from the normal condition. It is not less interesting and important to learn the nature and causes of abnormalities in form and function than it is to become familiar with the norm, and when this knowledge may aid in the prevention and relief of suffering, added dignity and interest are imparted to the study.

As there comes a line where the distinction between the normal and the abnormal is shadowy and uncertain, so the separation between normal and pathological biology is not sharp. The province of the one encroaches at many points upon that of the other. Mutual aid is to be derived from a closer union between normal and pathological biology. The pathologist should not be content with methods of research less perfect than those employed in normal biology. He should not rest satisfied with results which stop at the mere description and classification of morbid processes. To be able to give a name to some pathological lesion, and to make it fit

into some accepted scheme of classification, should not be the sole aim of pathological study. Pathological processes should be studied with the aim of elucidating their real nature, development and causes, their mutual relations and their dependence upon underlying laws. The purely descriptive phase of development of any natural science can be only temporary and unsatisfactory. The more a pathologist is embued with the spirit of modern biology, the less content will he be to stop at this descriptive phase.

In the next place it can be justly claimed that the study of pathology as a science without immediate reference to practical results is in reality the method which is most likely to yield these results as well as to bear fruit in other directions. Experience has shown that the most important discoveries in science, come not from those who make utility their guiding principle, but from the investigators of truth for its own sake, wherever and however they can attain it. It is shortsighted to fail to see that the surest way to advance pathology, even in its relations to practical medicine, is to cultivate it as a science from all points of view. It is impossible to foresee what may be the practical application tomorrow of any pathological fact discovered in the laboratory, no matter how remote from practical bearing it may seem today.

The experiments upon animals and other investigations which have led to the present accuracy in the localized diagnosis of lesions of the central nervous system, and have rendered possible the surgical treatment of many of these lesions we owe in large part to physiologists and pathologists who had little thought of the practical applications of the results of their researches. The instrument and methods which have enabled ophthalmology to attain such perfection in diagnosis and treatment rest upon researches in physiological optics belonging to the domain of pure science. It could not have been anticipated by those who began the study of the microscopic organisms which cause fermentations and infectious diseases, that their study would lead to a revolution in surgical treatment, and would open prospects which it would now be hazardous to specify as to the prevention and cure of infectious diseases. Did time permit, and were it necessary, much more evidence of similar character could be brought forward to show that those who work in laboratories, it may be without a thought as to the practical utility of their investigations, are no less genuine contributors to the science and art of medicine, than those who study diseases by the bedside.

As has already been mentioned, pathology has to do with abnormalities, not in man alone, but in all living things, both animal and vegetable. The points of contact between animal and vegetable pathology are more numerous than might at first glance appear. The student of animal pathology

can draw many instructive lessons from such subjects as the behavior of wounds and the parasitic affection in plants.

We are most of us probably inclined to think too much of the separation between the pathology of man and that of the lower animals. While there is a wide distinction in the dignity of the object of study, yet from a scientific point of view this separation is of little account. Pathological investigations of diseases of animals constitute no less genuine and valuable contributions to pathology in general than do similar investigations of human diseases. The advancement of recent years in the education and aims of those who devote themselves to animal pathology, will serve to bring into closer relations the students of human and those of comparative medicine.

It may be useful for us to consider briefly some of the relations and points of contact between human and comparative pathology.

In the first place there are many diseases which are common to man and to animals. These can often be studied to greater advantage upon animals in which many conditions can be controlled, which are beyond our control in man. In animals every stage of development of the disease can be studied, and in general, fresher material can be obtained. We can modify in various ways external and internal conditions so as to reach a clearer comprehension of the morbid processes. Moreover the same disease may present interesting pathological peculiarities in different species of animals, so that the study of its occurrence in a single species, affords incomplete knowledge. For instance, the pathologist whose sole knowledge of such a disease as tuberculosis is derived from the study of the disease as it occurs in man, has a far less complete understanding of this affection, than one who is also familiar with the striking peculiarities of this affection in cattle, swine, fowls, and other animals.

Especial importance attaches, of course, to the study of such diseases as are communicable from animals to man, as for instance, anthrax, glanders, tuberculosis, many entozoic affections, etc., and in general these are the animal diseases which have received the most attention from the students of human pathology.

One of the most important departments of comparative pathology is experimental pathology, the value of which to human pathology has long been recognized. To make of experimental pathology a distinct specialty and to endow it with a separate professorship as is done in some foreign universities, does not seem to me to be in the direction of the most fruitful and healthy development. The experimental method is the handmaid of pathology in all its branches, and is the only means of solving many important problems. The experimental production of diseases in the lower

animals affords an insight to be gained in no other way as to the causes, development, lesions and functional manifestations of many diseases. Experience, however, has shown that grave errors are likely to be committed by experimental pathologists who have no knowledge of the natural diseases and conditions of the animals used for experimentation. How often, for example, have those studying the question of experimental tuberculosis, mistaken for genuine tubercles nodules produced by parasitic entozoa and to what misleading conclusions have such incorrect observations led.

There are many general pathological processes which can be studied to better advantage in animals than in man. Such subjects as inflammation, oedema, thrombosis, embolism, and infection have been elucidated in large part by observations made on animals. Due caution is of course to be exercised in applying such observations directly to human beings. In as much as it is rarely possible for us to produce artificially all of the conditions which cause natural diseases, and as our very method of experimentation is in itself often a perturbating factor, it is no less important to study animal diseases resulting from natural causes, than it is to study the same diseases experimentally produced. Of course there are many diseases which have not yet been opened to the experimental method of investigation.

Questions of etiology and of pathogenesis are among those which have received and are destined still further to receive the greatest illumination from studies of comparative pathology. At present, probably no subject engages the attention of pathologists to a greater degree than the microscopic organisms which cause infection. If we had been confined to human beings in the study of infectious diseases, our knowledge in this direction would have been only a small fraction of what it is at present. In scarcely a single instance could the complete chain of proof required to demonstrate the causation of an infectious disease by a specific microorganism have been furnished. The far-reaching principle of preventive vaccination or inoculation would not be known.

A most important and promising field of pathological study, at present only partly cultivated, is found in the infectious diseases of animals and of plants, not only on account of the great economic interests often involved, but also as a means of widening and deepening our conceptions as to the causes, development, prevention and treatment of infectious diseases in general. Any pathologist who is at all familiar with the remarkable and peculiar conditions under which the so-called Texas Cattle Fever of the United States develops and spreads, will realize that the complete elucidation of all the etiological factors of this disease not only would contribute to the solution of a great economic question, but also would open fresh

points of view in our conceptions of infectious agents and their properties. When we consider the many conditions which it is in our power to control in studying animal diseases, and above all the possibility of submitting to an experimental crucial test our conclusions, it is clear that the study of natural and artificial infections, as well as of many other diseases in animals, is calculated to advance in the highest degree the science of pathology. It is not a small thing that questions which were once considered to be wholly transcendental, as for instance the doctrine of immunity against infectious disease, have been brought within the working domain of experimental pathology.

Nor is it in the causation of infectious diseases alone that the comparative study of human and animal diseases is destined to advance etiology. It is reasonable to expect that this comparative study will help to clear up many factors, at present obscure, in the causation of human diseases, including the influence of social conditions.

But let us take a broader view of comparative pathology than that which considers abnormalities only in man and in animals related to man in structure and function. I believe that many problems and facts in human pathology await for their complete elucidation the same application of the comparative method of study which has made of normal anatomy virtually a new science. What a barren mass of apparently unrelated facts is human anatomy when studied without reference to comparative anatomy and embryology? If knowledge is the understanding of the real nature of a thing, and how it came to be as it is, then there is no knowledge of human anatomy without the aid of comparative anatomy and embryology. How difficult and unmeaning is the old method of studying the anatomy of the human brain and how fascinating does the anatomy of this organ appear in the light of development!

A light similar in kind, if not equal in intensity, will be shed upon human pathology by a fuller insight into comparative pathology. We possess at present scarcely the rudiments of a comparative general pathology, but how useful and significant is even our fragmentary knowledge of this subject. The charm and impressiveness with which Metchnikoff has developed and presented the phagocytic doctrine is due largely to illustrations drawn from comparative pathology. It is impressive to see pictured in living forms from the lowest up to the highest, the combat with invading microorganisms of infection. While the phagocytic doctrine cannot be accepted in its entirety, it is interesting to observe that it received its origin and its chief support from observations made upon the lower forms of life, rather than from those on man and the higher animals.

The interesting and important discoveries concerning the curious parasitic organisms associated with malaria may seem to the student of human pathology anomalous and without analogy, but in Prof. Wright's admirable address today upon the sporozoa, we have had presented to us not only the life history of the class of organisms to which the malarial parasites probably belong, but also many examples of similar parasitic affections of lower animals. We may expect still further information concerning this interesting group of infectious microorganisms from researches in comparative pathology.

Take for instance one of the most disputed and still unsettled problems in pathology, the conditions which cause multiplication of the fixed cells of the body, a question which is intimately associated with the still broader one of the response of cells to the action of external stimuli. Can it be doubted that if we were acquainted with the behavior of cells in all types of living things, from the unicellular organism upward, under the influence of such stimuli as cause inflammation in human beings, under the influence of losses of substance and under various other conditions, we should have a much clearer comprehension of one of the fundamental and most common pathological processes in man.

The interesting studies of heredity, by Weissmann and others, pertain in part to pathology and also illustrate brilliantly the value of the comparative method of research.

The application of embryology to the explanation of congenital malformations is familiar and has long been an acquisition of human pathology. More recent is the endeavor to refer the origin of the genuine tumors to anomalies in foetal development. It is probable that experimental and comparative pathology also will shed much light upon the still obscure question as to the origin of tumors.

A large mass of observed pathological facts we must now accept without adequate explanation. It is often the fundamental and common morbid processes which are most obscure. For many of these we may hope to find satisfactory explanation in the results which the comparative study of pathology will afford. At present nothing is to be gained by attempting to generalize from scanty and incomplete observations in comparative pathology. We must first accumulate a store house of facts. We need investigators who shall study pathological conditions not in man alone, or in the higher animals alone, but also in the simpler forms of plant and animal life. Something has been done in this direction, more indeed than is generally utilized in human pathology, but much more remains to be done. Conditions and processes which are difficult to comprehend in animals of complex organization often become clear in organisms of simple structure.

Our pathological concepts are now derived almost wholly from observations made upon highly complex forms of life. I believe it to be no illusion to anticipate in thought a time when all forms and kinds of living matter will be included in the domain of pathology, and when pathological laws will be derived from results of investigations which begin with unicellular organisms and which end with man. By the adoption of this comparative method of study, pathology will in reality acquire greater simplicity and deeper significance than it now possesses.

As the student of normal biology does not attempt to cultivate equally the whole field belonging to his subject, so the pathologist cannot be expected to cover in his investigations, the whole domain of pathology as thus broadly outlined. There will be special workers in various departments. As in normal biology, so in pathological biology from the combined labors of all there will be constructed a science broader, richer and fuller of meaning than that which we now possess.

The ideas which I have endeavored to present, although necessarily in a brief and cursory manner, concerning pathology in its relations to general biology, are naturally suggested by the opening of this biological laboratory. Permit me in conclusion to say that it is in a medical school in intimate and organic connection with a university where such laboratories exists, that the highest cultivation of pathology as a science is to be expected.

Here is a favorable atmosphere, here the stimulus of allied sciences, and here the most enlightened appreciation and encouragement.

THE EVOLUTION OF MODERN SCIENTIFIC LABORATORIES[1]

The scientific discoveries of the present century have had such a profound influence upon inventions, upon industries, and upon the comfort, health and welfare of the people in general, that there is wide spread, even if not always adequate, appreciation of the value of scientific study and investigation. But it may be doubted whether there is any proper understanding, in the minds even of the educated public, of the material circumstances which surround scientific discovery and which make it possible. The average man, if interested at all, is interested that the discovery is made, not how it is made.

In this country, where we must rely mainly upon enlightened private beneficence, and not upon governmental aid, to furnish the pecuniary resources which are essential for scientific progress, it is important that there should be some general information not only regarding the results of scientific work, but also regarding the external material conditions necessary for the fruitful prosecution of such work.

At the present day the systematic study and advancement of any physical or natural science, including the medical sciences, requires trained workers who can give their time to the work, suitably constructed workrooms, an equipment with all of the instruments and appliances needed for the special work, a supply of the material to be studied, and ready access to the more important books and journals containing the special literature of the science.

All of these conditions are supplied by a well equipped and properly organized modern laboratory. Such laboratories are, with the partial exception of the anatomical laboratory entirely the creation of the present century, and for the most part of the last fifty years. They have completely revolutionized during the past half-century the material conditions under which scientific work is prosecuted. They are partly the result, and in larger part the cause, of that rapid progress of the physical and natural sciences which characterizes the era in which we are living.

The evolution of the modern laboratory still awaits its historian. It is not difficult to find incidental references to historical facts bearing upon this subject. The development of the chemical laboratory has been traced with some fulness. But it is curious that there is no satisfactory monographic treatment of the general subject of the historical development of scientific laboratories. The subject seems to me an attractive one. It would surely be interesting to trace the development of the teaching and the investigating laboratory back to its beginnings, to learn about the material circumstances

[1] An address delivered at the Opening of the William Pepper Laboratory of Clinical Medicine, Philadelphia, December 4, 1895.

Johns Hopkins Hosp. Bull., Balt., 1896, VII, 19-24.

under which the physicists, the chemists, the morphologists, and physiologists of former generations worked. What share in the development of laboratories had the learned academies of the Renaissance and of the subsequent centuries? What share had public and private museums and collections of instruments of precision? What share had the work of the exact experimentalists, beginning with Galileo, of physicians, of the alchemists, and of the apothecaries? What individuals, universities, corporations, and governments were the pioneers in the establishment of laboratories for the various physical and natural sciences? The detailed consideration of these and many other questions pertinent to the subject would make an interesting and valuable historical contribution.

There is evidence that in Alexandria, under the early Ptolemies in the third century before Christ, there existed state-supported institutes, in which students of man and of nature could come into direct personal contact with the objects of study, and by the aid of such appliances as were then available could carry on scientific investigations. The practical study of anatomy, physiology, pathology, and other natural sciences was here cultivated. We are very imperfectly informed as to the results and the material circumstances of this remarkable period in the history of science. We know that after about a century of healthy activity the Alexandrian school gradually sank into a place for metaphysical discussions.

Fifteen hundred years elapsed before we next find any record of the practical study of the natural science. In 1231, the great Hohenstaufen, Frederick the Second, who has been called the most remarkable historic figure of the Middle Ages, commanded the teachers at Salernum diligently to cultivate the practical study of anatomy. After the passage of this edict occasional dissections of the human body were made, but it cannot be said that there was any diligent cultivation of anatomy on the part either of teachers or of students during the following two centuries.

In the latter half of the fifteenth century there developed that active interest in the practical study of human anatomy which culminated in the immortal work of Vesalius, published in 1543. After this the study of anatomy by dissections gradually assumed in the medical curriculum that commanding position which it has maintained up to the present day.

For over six hundred years there has been at least some practical instruction in anatomy, and for over three hundred years there have existed anatomical laboratories for purposes of teaching and of investigation, although only those constructed during the present century meet our ideas of what an anatomical laboratory should be. It is a matter of no little interest, both for the history of medicine and for that of science in general, that the first scientific laboratory was the anatomical laboratory. Private laboratories for investigation must have existed from the earliest times. Doubtless

Aristotle had his laboratory. But the kind of laboratory which we have on this occasion in mind is one open to students or investigators or both. There was no branch of physical or natural science, with the exception of anatomy, which students could study in the laboratory until after the first quarter of the present century. Only in anatomy could students come into direct contact with the object of study and work with their own hands and investigate what lay below the surface.

The famous Moravian writer on education, Amos Comenius, over two hundred and fifty years ago, gave vigorous expression to the conception of living, objective teaching of the sciences. He said, "Men must be instructed in wisdom so far as possible, not from books, but from the heavens, the earth, the oaks and the beeches—that is, they must learn and investigate the things themselves, and not merely the observations and testimonies of other persons concerning the things." "Who is there," he cries, "who teaches physics by observation and experiment instead of by reading an Aristotelian or other text-book?" But how little ripe were the conditions then existing for the successful carrying out of ideas so far in advance of his times is illustrated by the very writings of the author of "Orbis Pictus" and "Lux in Tenebris."

It would lead too far afield to trace in detail on this occasion the development of physical and of chemical laboratories, but on account of the intimate connection between the development of physics and chemistry and that of medicine, especially of more exact experimental work in the medical sciences, a few words on this subject will not be out of place.

Methodical experimentation in the sciences of nature was definitely established by Galileo and was zealously practised by his contemporaries and successors in the seventeenth century. It was greatly promoted by the foundation during this century of learned societies, such as the Accademia dei Lyncei and the Accademia del Cimento in Italy, the Collegium Curiosum in Germany, the Académie des Sciences in Paris, and the Royal Society in England. Much of the classical apparatus still employed in physical experiments was invented at this period. Experimental physics from the first acquired a kind of fashionable vogue, and this aristocratic position it has ever since maintained among the experimental sciences. These sciences must concede to physics that commanding position which it has won by the genius of the great natural philosophers, by the precision of its methods and the mathematical accuracy of its conclusions, and by the fundamental nature and profound interest and importance of its problems. The debt of the medical sciences to the great experimental physicists, from Kepler and Galileo and Newton down to Helmholtz, is a very large one, larger than is probably appreciated by medical men who have not interested themselves in the history of experimental and precise methods in medicine.

There existed in the last century cabinets of physical apparatus to be used in demonstrative lectures, but they were very inadequate, and suitable rooms for experimental work scarcely existed. It was not until about the middle of the present century that we find the beginnings of the modern physical laboratory. Lord Kelvin, then William Thomson, established a physical laboratory in the University of Glasgow about 1845 in an old wine-cellar of an house. He tells us that "this, with the bins swept away, and a water supply and sink added, served as a physical laboratory for several years." It was as late as 1863 that Magnus opened in Berlin his laboratory for experimental physical research. Since 1870 there has been a rapid development of those splendid physical institutes which are the pride of many universities.

Humbler but more picturesque was the origin of the chemical laboratory. This was the laboratory of the alchemist searching for the philosopher's stone. In the painter's canvas we can still see the vaulted, cobwebbed room with its dim and mysterious light, the stuffed serpent, the shelves with their many colored bottles, the furnace in the corner with the fire glowing through the loose bricks, the fantastic alembics, the old alchemist in his quaint armchair reading a huge, worm-eaten folio, and the assistant grinding at the mortar. Fantastic and futile as it all may seem, yet here was the birth of modern chemistry. The alchemists were the first to undertake the methodical experimental investigation of the chemical nature of substances. No more powerful stimulus than the idea of the philosopher's stone could have been devised to impel men to ardent investigation. But search for gold was not all that inspired the later alchemists. Paracelsus, the alchemist, that strange but true prophet of modern medicine as he was of modern chemistry, said, "Away with these false disciples who hold that this divine science, which they dishonor and prostitute, has no other end but that of making gold and silver. True alchemy has but one aim and object, to extract the quintessence of things, and to prepare arcana, tinctures, and elixirs which may restore to man the health and soundness he has lost." And again he says of the alchemists, "They are not given to idleness nor go in a proud habit or plush or velvet garments, often showing their rings upon their fingers, of wearing swords with silver hilts by their sides, or fine and gay gloves upon their hands, but diligently follow their labors, sweating whole days and nights by their furnaces. They do not spend their time abroad for recreation, but take delight in their laboratory. They wear leather garments with a pouch and an apron wherewith to wipe their hands. They put their fingers among coals and into clay, not into gold rings."

During the seventeenth and eighteenth centuries the doctrines and work of the alchemists had profound influence upon medicine. Alchemy was not completely overthrown until Lavoisier gave the deathblow to the phlogistic

theory of Stahl. But for a considerable time before Lavoisier introduced the new spirit into chemistry, its methods and its problems were gradually approaching those of modern times. It was, however, over thirty years after the tragic death of Lavoisier before the first chemical laboratory in the modern sense was established. One cannot read without combined feelings of wonder and pity of the incommodious, forlorn, and cramped rooms in which such men as Scheele and Berzelius and Gay Lussac worked out their memorable discoveries. Liebig has graphically described the difficulties encountered by the student of that day who wished to acquire practical training in chemistry. With some of the apothecaries could be obtained a modicum of practical familiarity with ordinary chemical manipulations, but Sweden and France were the centers for those with higher aspirations.

It was the memory of his own experiences which led Liebig, immediately after he was appointed professor of chemistry in Giessen in 1824, to set about the establishment of a chemical laboratory. Liebig's laboratory, opened to students and investigators in 1825, is generally stated to be the first modern public scientific laboratory. Although, as we shall see presently, this is not quite correct, it is certain that Liebig's laboratory was the one which had the greatest influence upon the subsequent establishment and organization not only of chemical laboratories, but of public scientific laboratories in general. Its foundation marks an epoch in the history of science and of scientific education. This laboratory proved to be of great import to medical science, for it was here, and by Liebig, that the foundations of modern physiological chemistry were laid.

The significance of this memorable laboratory of Liebig is not that it was a beautiful or commodious or well equipped laboratory, for it possessed none of these attributes,—indeed, it is said to have looked like an old stable,—but that here was a place provided with the needed facilities and under competent direction, freely open to properly prepared students and investigators for experimental work in science.

The chemical laboratories of today are, in general, the best organized and the best supported of scientific laboratories.

The need of establishing physiological laboratories was recognized several years before the foundation of Liebig's laboratory. The important results to be derived from the application of the experimental method to the study of vital phenomena had been demonstrated first and most signally by Harvey, and after him by many experimenters. The fecundity of exact experimentation by physical and chemical methods applied to the phenomena of life had been shown by the classical researches of Lavoisier on respiration and animal heat. Magendie had entered upon that remarkable scientific career which entitles him to be regarded as the founder of modern experimental physiology, pathology, and pharmacology.

In 1812, Gruithuisen, who, after the custom of the times, filled an encyclopaedic chair, being professor in Munich of physics, chemistry, zootomy, anthropology, and later of astronomy, published an article advocating the establishment of physiological institutes. In 1823, Purkinje, one of the most distinguished physiologists of this country, accepted the professorship of physiology in Breslau, this being the first independent chair of physiology in any German university. In 1824, Purkinje succeeded in establishing a physiological laboratory, which therefore antedates by one year Liebig's chemical laboratory in Giessen, although it cannot be said to have exercised so great an influence upon the organization of scientific laboratories in general as did the latter. In 1840, Purkinje obtained a separate building for his laboratory.

With two or three exceptions, all of the separate physiological laboratories worthy of the name have been established since the middle of the present century. Bernard, that prince of experimenters, worked in a damp, small cellar, one of those wretched Parisian substitutes for a laboratory which he has called "the tombs of scientific investigators." There can be no greater proof of the genius of Bernard than the fact that he was able to make his marvellous discoveries under such obstacles and with such meagre appliances. France was long in supplying her scientific men with adequate laboratory facilities, but no more unbiased recognition of the value and significance of the German laboratory system can be found than in the reports of Lorain, in 1868, and of Wurtz, in 1870, based upon personal study of the construction and organization of German laboratories.

Of modern physiological laboratories, the one which has exerted the greatest and most fruitful influence is unquestionably that of the late Professor Ludwig in Leipzig. This unequalled position it has won by the general plan of its organization, its admirable equipment, the number and importance of the discoveries there made, its development of exact methods of experimentation, the personal character and genius of its director, and the number of experimenters there trained from all parts of the civilized world.

Today every properly equipped medical school has its physiological laboratory. This department is likely to continue to hold its place as the best representative of exact experimental work in any medical science. A good knowledge of physiology is the best corrective of pseudoscientific, irrational theories and practice in medicine.

Physiological chemistry has been an important department of research for over half a century, but it is only within recent years that there have been established independent laboratories for physiological chemistry. A large part of the work in this branch of science has been done hitherto in laboratories of general chemistry, of physiology, of pathology, and of clin-

ical medicine. A physiological laboratory cannot well be without a chemical department, and the same is true of several other medical laboratories; but it seems to me that physiological chemistry has won its position as an independent science, and will be most fruitfully cultivated by those who with the requisite chemical and biological training devote their entire time to it. The usefulness of independent laboratories for physiological chemistry has been shown by the work done in Hoppe-Seyler's laboratory in Strassburg since its foundation in 1872. This was the first independent laboratory of physiological chemistry.

The first pathological laboratory was established by Virchow, in Berlin, in 1856. About this time he wrote: "As in the seventeenth century anatomical theatres, in the eighteenth clinics, in the first half of the nineteenth physiological institutes, so now the time has come to call into existence pathological institutes, and to make them as accessible as possible to all." It cannot be doubted that the time was fully ripe for this new addition to medical laboratories. Virchow secured his laboratory as a concession from the Prussian government upon his return from Würzburg to Berlin. Virchow's laboratory has been the model as regards general plan of organization for nearly all pathological laboratories subsequently constructed in Germany and in other countries. It embraced opportunities for work in pathological anatomy, experimental pathology, and physiological and pathological chemistry. This broad conception of pathology and of the scope of the pathological laboratory as including the study, not only of diseased structure, but also of disordered function, and as employing the methods, not only of observation, but also of experiment, should never be lost sight of.

The first to formulate distinctly the conception of pharmacology as an experimental science distinct from therapeutics and closely allied by its methods of work and by many of its problems to physiology, was Rudolph Buchheim. This he did soon after going to Dorpat in 1846 as extraordinary professor of materia medica, and it was apparently not long after he there became ordinarius in 1849 that he established a pharmacological laboratory in his own house and by his private means. Later, this laboratory became a department of the university and developed most fruitful activity. Buchheim's laboratory was the first pharmacological laboratory in the present acceptation of this term. The conception of pharmacology advocated by Buchheim has been adopted in all German universities, and in not a few other universities; but it cannot be said to have been as yet generally accepted in the medical schools of this country and of Great Britain, although it seems destined to prevail.

The medical science which was the latest to find domicile in its own independent laboratory is hygiene. To Pettenkofer belongs the credit of first establishing such a laboratory. Since 1847 he had been engaged with

hygienic investigations, and in 1872 he secured from the Bavarian government the concession of a hygienic institute. This admirably equipped laboratory was opened for students and investigators in 1878. By this time Koch had already begun those epochal researches which, added to the discoveries of Pasteur, have introduced a new era in medicine. The introduction by Koch of new methods of investigating infectious diseases and many hygienic problems became the greatest possible stimulus for the foundation of laboratories of hygiene and bacteriology, and to some extent also of laboratories of pathology. The results already achieved by these new methods and discoveries in the direction of prevention and cure of disease, and the expectation of no less important results in the future, constitute today our strongest grounds of appeal to governments and hospitals and medical schools and the general public for the establishment and support of laboratories where the nature, the causes, the prevention, and the cure of disease shall be investigated. You have established here, in this city, and in connection with this university, the first hygienic laboratory of this country, housed in its own building and assured, I believe, of a future of great usefulness.

It is apparent, from the brief and imperfect outline which I have presented of the evolution of modern scientific laboratories, that the birthplace of these laboratories, regarded as places freely open for instruction and research in the natural sciences, was Germany. Such laboratories are the glory today of German universities, which possess over two hundred of them. By their aid Germany has secured since the middle of the present century the palm for scientific education and discovery.

Great scientific investigators are not limited to any country or any time. There are those of surpassing ability who will make their own opportunity and will triumph over the most discouraging environment. This country and every civilized country can point to such men, but they are most exceptional. The great majority of those even with the capacity for scientific work need encouragement and opportunity. We now have sufficient knowledge of the workings of scientific laboratories to be able to assert that in general where the laboratory facilities are the most ample and the most freely available, there are developed the largest number of trained workers, and there the discoveries are the most numerous and the most important. At the present day no country, no university, and no medical school can hold even a respectable place in the march of education and progress unless it is provided with suitable laboratories for scientific work.

A properly equipped and properly conducted scientific laboratory is a far more expensive institution than is usually conceived. It must be suitably domiciled either in a separate building or in rooms commodious and well lighted. The outside architectural features are of secondary importance.

The instruments and appliances necessary for exact observation and experiment, even in those sciences which apparently require the least, are numerous and costly. A working library, containing the books and sets of journals most frequently consulted, is most desirable, if not absolutely indispensable. The director of the laboratory should be a man of ability and experience, who is a master in his department of science. He must have at least one assistant, who is preferably a young man aiming to follow a scientific career. A person of no small value in the successful working of the laboratory is the intelligent janitor or "diener," who can be trained to do the work of a subsidiary assistant and can be intrusted with the care and manipulation of instruments. There must be funds for the purchase of fresh supplies and new instruments when needed. The running expenses of a first-class laboratory are not small.

But, costly as may seem the establishment and support of a good laboratory, the amount of money expended for laboratories would seem to us ridiculously insignificant, if we could estimate the benefits to mankind derived from the work which has been done in them. Wurtz has truly said of the money required for laboratories, "It is a capital placed at a high rate of interest, and the comparatively slight sacrifice imposed upon one generation will bring to following generations increase of well-being and knowledge."

The educational value of the laboratory cannot well be overestimated. For the general student this is to be found primarily in the development of the scientific habit of thought. He learns that to really know about things it is necessary to come into direct contact with them and study them. He finds that only this knowledge is real and living, and not that which comes from mere observation of external appearances, or from reading or being told about things, or, still less, merely thinking about them.

The problem of securing for the student of medicine the full benefits of laboratory instruction in the various medical sciences is a difficult one, and cannot, I believe, be solved without considerable readjustment of existing schemes of medical teaching, but this subject is one which I cannot attempt to consider here.

The whole face of medicine has been changed during the last half-century by the work of the various laboratories devoted to the medical sciences. Anatomy, physiology and pathology now rank among the most important of the sciences of nature. They have been enriched with discoveries of the highest significance and value not only for medicine, but also for general biology. Although we have not penetrated, and perhaps may never penetrate, the mystery of life, we are coming closer and closer to an understanding of the intimate structure and the fundamental properties of living

matter. We already know that living matter is not that homogeneous, formless substance which, not many years ago, it was believed to be, but that it possesses a complex organization.

Practical medicine has been profoundly influenced by the unparalleled development of the medical sciences during the last fifty years, and especially during more recent years. Scientific methods have passed from the laboratory to the hospital. Cases of disease are now studied with the aid of physical and chemical and microscopical and bacteriological methods. The diagnosis of disease has thereby been greatly advanced in precision, and if Boerhaave's motto, *qui bene diagnoscit, bene medebitur,* be true, there should be a corresponding advance in the results of the treatment of disease. Whether or not this dictum of the old master be true—and I have serious doubts as to its entire truth—it cannot be doubted that great progress has been made in medical, and especially in surgical treatment as a result of scientific discoveries, although the treatment of disease still rests, and will doubtless long continue to rest, largely upon empirical foundations.

We are assembled here today to assist at the opening of a laboratory which gives the fittest and strongest possible expression to the influence of scientific work upon practical medicine. The generous founder has marked with characteristic insight the direction in which the current is setting.

The conception of a thoroughly equipped laboratory as an integral part of a hospital and intended for the study and investigation of disease is of recent origin. The germs of this idea, however, may be traced back to such men as Hughes Bennett and Beale in Great Britain, and to Frerichs and Traube in Germany, who in their hospital work made fruitful application of microscopical, chemical, and experimental methods. A little over ten years ago, von Ziemssen, in Munich, established a well conceived clinical laboratory, containing a chemical, a physical, and a bacteriological department, a working library, and rooms for practical courses and the examination of patients. A similar laboratory was secured by Curschmann in Leipzig in 1892.

The growing recognition of the need of such laboratories is the result of the great progress in scientific medicine during recent years. The thorough clinical examination of many cases of disease now requires familiarity with numerous technical procedures, physical, chemical, microscopical, and bacteriological. The laboratory outfit required simply for routine clinical examinations is considerable. A microscope and a few test tubes and chemical reagents for simple tests of the urine no longer suffice. As illustrations of this, I call attention to the clinical value of examinations of the blood, of the contents of the stomach, of fluids withdrawn from the serous cavities, of the sputum and various secretions, of fragments of tissue removed for

diagnosis. Such examinations require much time, trained observers, and considerable apparatus. To secure for the patients the benefits in the way of diagnosis, prognosis, and treatment to be derived from these methods of examination, a hospital should be supplied with the requisite facilities.

A hospital, and especially one connected with a medical school, should serve not only for the treatment of patients, but also for the promotion of knowledge. Where this second function is prominent, there also is the first most efficiently and intelligently carried out. Herein we see the far-reaching beneficence of a laboratory, such as this one, thoroughly equipped to investigate the many problems which relate to clinical medicine.

The usefulness of an investigating laboratory in close connection with a hospital has already been abundantly demonstrated. Chemical studies, more particularly those relating to metabolism in various acute and chronic affections, microscopical and chemical investigations of the blood and bacteriological examinations of material derived directly from the patient, may be mentioned as directions in which researches conducted in hospital laboratories have yielded important results and will garner still richer harvests in the future.

There need be no conflict between the work of clinical laboratories and that of the various other medical laboratories. Each has its own special field, but it is not necessary or desirable to draw around these fields sharp boundary lines beyond which there shall be no poaching. It will be a relief to pathological and other laboratories to have certain examinations and subjects relating directly to practical medicine consigned to the clinical laboratory, where they can receive fuller and more satisfactory consideration. The subject-matter for study in the clinical laboratory is primarily the patient and material derived from the patient. Anatomical, physiological, pathological, pharmacological, and hygienic laboratories must concern themselves with many problems which have apparently no immediate and direct bearing upon practical medicine. In the long run their contributions are likely to prove most beneficial to medicine if broad biological points of view, rather than immediate practical utility, are their guiding stars. The clinical laboratory will concern itself more particularly with questions which bear directly upon the diagnosis and the treatment of disease.

To the small number of existing well equipped clinical laboratories the William Pepper Laboratory of Clinical Medicine is a most notable addition. It is the first laboratory of the kind provided with its own building and amply equipped for research in this country, and it is not surpassed in these respects by any in foreign countries. It is intended especially for investigation and the training of advanced students. It is a most worthy memorial of the father of its founder.

William Pepper the elder was a very distinguished physician and trusted consultant of this city, for many years an attending physician at the Pennsylvania Hospital, where he was a clinical teacher of great influence, and for four years the professor of the theory and practice of medicine in this university. He belonged to that remarkable group of American physicians, trained under Louis, who brought to this country the best methods and traditions of the French school of medicine at the time of its highest glory. His diagnostic powers are said to have been remarkable. With his broad sympathies, his lofty ideals, and his active and enlightened efforts for the promotion of clinical medicine, how he would have welcomed such opportunities as will be afforded by this laboratory to contribute to a better knowledge of the nature, the diagnosis, and the treatment of disease!

Our country has until within a very few years been deprived of the encouragement and opportunities for original investigations in the medical sciences afforded by large and thoroughly equipped laboratories. We can still count upon the fingers of one hand our medical laboratories which are comparable in their construction, organization and appliances to the great European laboratories. Notwithstanding these obstacles, there have been American physicians of whose contributions to medical science we may feel proud.

But a new era has dawned. Of that we are witnesses here today. The value of medical laboratories is now widely recognized among us. To those of us who appreciate the underlying currents in medicine, who follow with eager interest the results of the almost feverish activities in foreign laboratories, who recognize the profound interest and importance of the many medical problems which await only patient investigation and suitable facilities for their solution, and who would like to see our country take the prominent position it should in these investigations, our laboratories may seem slow in coming, but they will in time be provided by enlightened benevolence. The individual or institution or hospital which contributes to the establishment of a good laboratory devoted to the medical sciences merits in unusual degree the gratitude of all medical men, yes, of every true friend of humanity. Such gratitude we feel for the generous and public-spirited founder of this laboratory, who has contributed largely to the advancement of medicine in this country, and of whose splendid services to this university I need not speak in this presence.

I congratulate this city and this university and this hospital upon the important addition made by this laboratory to higher medical education and the opportunities for scientific work in this country. May the enlightened aims of the founder, and the hopes of all interested in the promotion of medicine in this country, be fulfilled by the scientific activities which will now begin in the William Pepper Laboratory of Clinical Medicine.

THE JOURNAL OF EXPERIMENTAL MEDICINE[1]

The need of an American journal devoted especially to the publication of original contributions to the medical sciences has been keenly felt for some time. Our investigators in these departments have hitherto been obliged either to publish their scientific papers, often in condensed form and imperfectly illustrated, in periodicals devoted mainly to the practical branches of medicine, or to send them, as has become increasingly the custom, to various scientific journals of Europe. The result has been that we ourselves, and in still greater measure foreigners, do not know where to look for many of the widely scattered contributions of American workers to physiology, pathology, bacteriology, and other medical sciences.

In consequence of the absence of such a journal as is here contemplated there has been a lack of the close contact and free interchange of ideas, both between our own workers and between American and foreign investigators, which are fruitful in stimulating scientific research and in securing both here and abroad due consideration of work done in this country.

An American Journal devoted exclusively to the publication of original work in the medical sciences should aid materially that rapid advancement of scientific medicine which has been evidenced during recent years in this country by the elevation of the standards of medical education, by the establishment of well-equipped laboratories for the various medical sciences, by the increase in the number of well-trained workers to make use of these greater opportunities, by the growing number and importance of the contributions of American medical investigators, and by the wider appreciation and more generous support of scientific medical work.

It is believed to be for the interest both of the scientific worker and of the medical public that the first journal of this character established in this country should, like similar pioneer journals and some existing journals in other countries, embrace within its scope various allied medical sciences.

The title "The Journal of Experimental Medicine" has been selected in preference to a more specific but cumbersome designation in order to indicate broadly that the journal is not intended for purely clinical contributions. In medical, no less than in other, sciences the great advances of modern times have been owing to the method of experiment combined

[1] Introduction to the First Volume of the Journal of Experimental Medicine. J. Exper. M., N. Y., 1896, I, 1-3.

with that of exact observation. The term "Experimental Medicine" in the title is not intended to imply that the publication of investigations based upon observation is not within the province of the journal. Anatomical contributions both to physiology and to pathology are included within its scope.

It is intended that contributions in physiology and physiological chemistry shall be a prominent feature of the journal. Physiology is the foundation of scientific medicine, and the combined representation in the journal of physiology and pathology emphasizes their intimate union and mutual relations.

Pharmacology regarded as an experimental science, closely allied by its methods of work and by many of its problems to physiology, finds appropriate place in a journal of experimental medicine.

Studies in general pathology and pathological anatomy will constitute a large and important part of the material of the journal.

While the broad and diversified field of modern hygiene cannot be embraced in its entirety within the domain of the journal, there are many directions of experimental research in this department which may be appropriately included.

The epochal discoveries of the causal relations of microorganisms to infectious diseases have opened a fruitful and important field of research. No medical science is today cultivated more zealously and with more significant results than that of bacteriology, which will occupy a position in the journal commensurate with its great importance.

While purely clinical observations do not come within the domain of "The Journal of Experimental Medicine," its pages will be open to the publication of investigations such as are now made in some hospitals and clinical laboratories. Methods of the laboratory, microscopical, chemical, and bacteriological, have found fruitful application in the study of disease in the living patient, as is shown by the results of such hospital studies as those on the blood, on metabolism, on gastric contents, on the presence and significance of microorganisms in infectious processes. It is in such directions as those here indicated that medicine appears as one of the departments represented in the journal.

Although the subjects embraced within the scope of this journal, as thus outlined, are highly specialized, still they have many interests in common as to their methods and problems and purposes, and it is believed that their alliance in the present journal will prove of mutual advantage, will promote scientific medicine, and is best adapted to existing conditions in this country.

With the editor will cooperate a board of associate editors who are leading representatives of their special departments in the United States and Canada. The assistance of a large number of distinguished American collaborators who are active workers in the departments represented in the journal has been secured. The gratifying success in obtaining this general cooperation, and the many spontaneous expressions of good will and approval which have already been received, inspire confidence that "The Journal of Experimental Medicine" will be truly representative of scientific medicine in the United States and Canada.

THE EDITOR.

THE INFLUENCE OF ANAESTHESIA UPON MEDICAL SCIENCE[1]

Mr. President, Gentlemen of the Board of Trustees and of the Medical Staff of the Massachusetts General Hospital, Ladies and Gentlemen.—Five months ago was celebrated the centennial anniversary of that grand discovery by Jenner which brought under subjection the most prevalent and horrible scourge of former centuries. Today we have assembled in this famous hospital on the very spot, made memorable for all time, where fifty years ago William Morton first demonstrated to the world the art of surgical anaesthesia, the happiest gift ever conferred upon mankind by medical science or art. We may add to vaccination and anaesthesia the more recent introduction of antisepsis by Lister; and we can truthfully say that all the previous centuries can show no achievement of the art of the physician or surgeon comparable in beneficence to any one of these triumphs of the last hundred years.

It is in consequence of their enduring utility and benefit to humanity that these discoveries, which have led to the mastery over a pestilence, the annulment of pain and the safe healing of wounds, merit the everlasting gratitude of the world. But it is fitting on such a commemorative occasion as this, that, while these practical aspects receive their due consideration, we forget not the debt which these great discoveries owe to science nor the debt which science owes to them. It is, therefore, most appropriate that those who arranged the programme to commemorate this fiftieth anniversary of the first public demonstration of surgical anaesthesia should have chosen as one of the themes to be here presented, "The Influence of Anaesthesia upon Medical Science." Their wisdom I am sure was less conspicuously manifested in their selection of the medium for the presentation of this subject, highly as I esteem the honor of being invited to speak upon this occasion.

In the limited time allotted to an individual speaker I cannot hope to do more than to present in outline some of the salient aspects of my theme.

I shall not attempt to trace the history of the discovery of surgical anaesthesia, a history which affords a lamentable illustration of how the awards of generous gratitude may be sacrificed to fruitless efforts to mete out equal and exact justice. I wish in this connection to call attention only to the fact

[1] **Remarks made October 16, 1896 at the Commemoration of the Fiftieth Anniversary of the First Public Demonstration of Surgical Anaesthesia at the Massachusetts General Hospital, Boston.**

Boston M. & S. J., 1896, CXXXV, 401-403.

that this discovery was made in the only way in which it possibly could have been made, and that is by the method of experimentation. The opponents of animal experimentation have endeavored to utilize for their purposes the alleged absence of experiments upon animals as the basis of this discovery. As a matter of fact, even leaving out of account the pioneer experiments upon animals by Humphrey Davy with nitrous oxide, the first successful trial of ether as a general anaesthetic for human beings by Morton was preceded by his demonstration of the power of this agent to produce in dogs unconsciousness and insensibility to pain. It would be strange, indeed, if these striking results of experiments upon animals had no influence in inducing him to test their applicability to human beings.

It must, however, be admitted that the production of anaesthesia in man by inhalation of ether was not preceded by such numerous and properly conducted experiments on animals as were required to afford any adequate conception of its effects or its possibilities of danger. We now know that such experiments would have yielded knowledge of this character. We know also that the anaesthetic sleep induced by ether in man as well as in animals is not attended with more than a minimal amount of danger; but suitable experiments upon animals would have afforded more knowledge than Morton could have possessed as to whether there was to be sure awakening from that sleep so like unto death. Hence it is that when that patient fifty years ago today in this hospital was placed under the profound influence of ether he was made the subject of a scientific experiment of immense practical import and of unsurpassed boldness. This was the decisive experiment from which dates "the continuous and consequent history" of anaesthesia.

The discovery of surgical anaesthesia is, I repeat, a triumph of the experimental method, albeit man himself was made the subject of experiment and thereby exposed to unknown possibilities of danger.

If my theme embraced the consideration of all of the relations of artificial anaesthesia to medical science, and did time permit, it would be proper for me to direct attention to the part played by animal experimentation in the discovery and introduction of new anaesthetics and to the numerous physiological and pharmacological experiments, mainly upon animals, which have shed so much light upon the mode of action of anaesthetics, particularly of ether and chloroform, and the sources of danger in their employment. Although not all of the questions involved have yet been solved, these experiments have furnished a large amount of knowledge of great scientific value and of much practical interest concerning the properties of anaesthetics, knowledge which it is certainly desirable to possess and much of which could not have been gained otherwise than by experiments upon animals.

I might speak also of the broad biological interest which attaches to the universal susceptibility of living matter to the sleep-producing influence of ether and chloroform, a susceptibility extending even to vegetable cells and the simplest unicellular organisms, also of how the gentle killing of certain bacteria by chloroform enables us to detect in their bodies toxic substances which are destroyed by more violent modes of death, and further of interesting properties of nerve and of muscle which have been revealed by studying under various conditions the action upon them of anaesthetic agents. But I do not interpret the subject assigned to me as including the consideration of such matters as these, interesting as they are, and it is certain that time would not permit even their sketchy presentation upon this occasion.

What I especially desire to emphasize in these brief remarks is that the utility of the discovery of anaesthetics is not limited to their practical application to the surgical and medical and obstetrical arts, but that this discovery has been of great service also to medical science upon which these arts in large part rest.

+ Anaesthetics appeared upon the scene at a time when the experimental medical sciences were entering upon an epoch of activity and success far surpassing anything previously known in the history of medicine. The shackles of philosophical speculation and dogma which bound medicine at the opening of this century had been broken by the work of such men as Bichat, Magendie, Johannes Müller, Rokitansky, Laennec and Louis. Their work was based upon exact observation and experiment, and there had come to be a general realization of the fact that these are the only trustworthy sources of knowledge. Animal experimentation, which, as a fruitful method of investigation, began with Harvey's discovery of the circulation of the blood, had in the hands of Charles Bell, Magendie, Müller and others yielded abundant proofs of its value. It was during the fourth decade of this century that those great experimenters, Claude Bernard, from the school of Magendie, and Du Bois-Reymond, Helmholtz, Brücke and Ludwig, from the school of Müller, started their epochal investigations in physiology. It was at the same period that Virchow and Traube began those researches which established animal experimentation, already successfully employed by John Hunter, as a most important aid in the development of pathological physiology. It was then also that experimental pharmacology, which had been inaugurated by Magendie, was first cultivated as a distinct branch of medical science by Buchheim. The need of suitably equipped laboratories where experimental investigations could be conducted was now felt more keenly than ever before. By being the first to supply these essential instruments of fruitful scientific activity, Germany took the lead in scientific discovery,

a position which her enlightened policy in the establishment and support of laboratories has enabled her ever since to retain.

The introduction of artificial anaesthesia came at this auspicious period of awakened activity, which gave such promise of the rapid development of scientific medicine through the aid of exact observation and experiment. And how brilliantly has this early promise been fulfilled by the discoveries of the last fifty years which have witnessed the creation of cellular pathology, the rapid development of physiology to a biological science of the first rank, conferring great benefits upon medicine but extending far beyond the boundaries of medicine, the establishment of pharmacology upon a broad scientific basis, and the birth of the science of bacteriology which has unlocked the gates to new fields whose brief exploration has already proven of such immense importance to preventive and curative medicine and practical surgery! It is true that, when we consider all that we may reasonably hope to learn concerning the structure and functions of living beings in health and in disease and how they may be influenced for good or for ill, only a corner of the curtain has been lifted, but when we compare the advance of medicine during the last fifty years with what was previously known, we can truthfully say that this advance has been greater during these years than during all the previous centuries.

A large and important part of this progress is attributable to the results obtained by means of experiments upon animals. One has only to imagine blotted out from the records of physiology, pathology, pharmacology, hygiene, bacteriology and other medical writings all of the facts which have been derived from animal experimentation to realize how immense would be the loss to both scientific and practical medicine, had investigators been deprived of this indispensable method of research. To point out in detail how broad and deep would be this gap cannot be even attempted in the short time here allotted, and would be surely unnecessary before this audience.

The use of anaesthetics has been such an important aid in the performance of these experiments upon animals during the past fifty years that it is eminently fitting on this jubilee that medical science should also pay its tribute to the beneficence of the great discovery here celebrated.

The ways in which anaesthetics have been serviceable to animal experimentation are essentially similar to those in which they have benefited surgery.

The great majority of painful vivisectional experiments upon the higher animals are of such a nature that the object of the experiment is not defeated by the employment of anaesthetics. In experiments of this class all trained experimenters should and do use anaesthetics, and there is no evidence that

there exists today any abuse of vivisection on this score in any properly conducted laboratory. The dictates of humanity demand that we shall gain for the benefit of man knowledge which can be acquired only from experiments upon animals, and they demand also that this knowledge shall be gained without the infliction of needless suffering. Humane instincts are not less active among those who devote themselves to acquiring knowledge in this way than among other classes of men, but these instincts in the former are controlled not by false sentiment but by reason and duty. It is a source of immense gratification to experimenters, as it should be to all with humane impulses, that in consequence of the discovery of artificial anaesthesia so large a part of the useful knowledge which can be derived only from experiments upon animals can now be acquired without the infliction of pain. To cite the animal experiments of pre-anaesthetic days, as for example those of Magendie, as illustrations of present methods of experimentation, is as unwarrantable as would be a similar procedure in describing surgical operations.

The advantages of anaesthesia are not limited by the mere abolition of pain. In animal experimentation as well as in surgery the insensibility to pain and the cessation of voluntary movements induced by anaesthetics have rendered many operations easy which would otherwise have been difficult, many practicable which would otherwise have been impossible. The success of the experiment is made much more certain when the operator can work at ease and without undue haste, undisturbed by the thought that he is inflicting pain. There are physiological experiments which, so far as I am able to judge, make greater demands upon the patience and operative skill and delicacy of manipulation of the operator than any in surgery, and these never could be performed upon a sensitive and struggling animal. Sensations of pain are in themselves a disturbing factor which would defeat the purpose of not a few delicate physiological experiments. The experiments to determine the functions of the brain, which have yielded results of great importance to practical medicine and surgery as well as to science, may be mentioned as one out of many illustrations of this fact. The antiseptic management of wounds, which is essential to the success of some experiments and which alleviates subsequent suffering when it is necessary that the animal should survive the experiment, is greatly facilitated by the use of anaesthetics.

I trust that I may be pardoned if I pause here for a moment to correct a misconception which does not exist among well informed medical men, least of all among practitioners of medicine, but which plays a considerable rôle in antivivisection literature. I refer to the distinction there made between the use of anaesthetics and that of narcotics for the purpose of rendering

animals insensible to pain. So far as the point in question is involved this distinction is ridiculous, and seems to be based upon a misunderstanding of some old physiological experiments. For prolonged experiments it is often advantageous to place the animal in the sleep induced by morphine or chloral instead of that of ether or chloroform. These drugs are administered in much larger doses, and often in different ways, than is customary in human beings. That under these circumstances the animal is rendered insensible to pain is a fact, the knowledge of which might have been gained from ordinary medical experience.

Curara is a drug which has important uses in a certain class of experiments upon animals. It has never been claimed by any scientific man that it is an anaesthetic, although it has been found capable of affording great relief from pain in some spasmodic affections of human beings. Its use has led to important physiological discoveries which could not well have been made without it, and in a limited class of cases its employment, either with or without the coincident administration of anaesthetics, is indispensable.

There are, of course, experiments upon animals in which there is no occasion to employ anaesthetics. Animal experimentation and vivisection are not coextensive terms. There is a large group of experiments, mostly of a painless character, in which there is no cutting or other operative interference whatever with the animal. Here belong many of the experiments upon metabolism, upon diet, upon the fate of drugs, etc. There are others in which the operative act is so slight or transitory that the animal would suffer far more discomfort from the administration of an anaesthetic than from the operation itself. There are, finally, painful vivisection experiments, relatively few in number however, whose purpose would be defeated by the use of anaesthetics. A striking example of such an experiment is that of Charles Bell in determining the motor and sensory functions of the nerve roots of the spinal cord, an experiment which, with those of Galvani, laid the foundations of modern nerve physiology.

Experiments upon animals have been and must continue to be an indispensable aid to the progress of scientific and practical medicine. In the performance of a large number of these experiments the use of anaesthetics is of priceless service. I trust that without presumption I may here express in behalf of the great body of scientific workers in medicine throughout the civilized world their feelings of gratitude for the great boon conferred upon medical science by the discovery of artificial anaesthesia, which in the form of a safe, useful and effective method, was first promulgated from this hospital fifty years ago today.

A CONSIDERATION OF THE INTRODUCTION OF SURGICAL ANAESTHESIA[1]

It is a happy conception of the trustees and staff of the Massachusetts General Hospital to set apart the sixteenth of October as "Ether Day," and to provide for the annual public celebration, in this historic place, of the anniversary of that most beneficent gift of medicine to mankind,—the introduction of surgical anaesthesia. I esteem it a high honor to be invited to deliver the annual address in commemoration of the great event which took place within these walls sixty-two years ago today. Of the significance of this event there can be no question, whatever controversy there may be concerning the exact share of all who participated in the discovery of surgical anaesthesia.

The attendant circumstances were such as to make the operation performed on Oct. 16, 1846, in the surgical amphitheater of this hospital, by John Collins Warren, upon the patient, Gilbert Abbott, placed in the sleep of ether anaesthesia by William Morton, the decisive event from which date the first convincing, public demonstration of surgical anaesthesia, the continuous, orderly historical development of the subject and the promulgation to the world of the glad tidings of this conquest of pain.

Had this demonstration or any subsequent one of like nature failed of success, it is improbable that we should have heard much of the claims to the prior discovery of surgical anaesthesia. Often as the story has been told, and full as it is of bitter controversy, I may be permitted to recall to your minds enough of the preceding discoveries and efforts to indicate the proper historical setting of the event which we celebrate.

When and by whom artificial anaesthesia was discovered is unknown. It is certain that the old Greek and Roman physicians were acquainted with the power of various narcotic drugs to produce insensibility to pain and that narcotic potions and even their fumes were frequently administered from ancient times onward before a surgical operation in order to lessen the sufferings of the patient. At a later period more limited use was sometimes made of certain devices for the same purpose, such as compression of the carotids, the tightening of a tourniquet and pressure upon nerve trunks.

[1] **An address delivered at the Massachusetts General Hospital on the Sixty-second Anniversary of Ether Day, Boston, October 16, 1908.**
Boston M. & S. J., 1908, CLIX, 599-604.

The Elizabethan dramatist, Middleton, even portrayed an age of surgical anaesthesia, when he wrote in one of his plays:

> "I'll imitate the pities of old surgeons
> To this lost limb, who, ere they show their art,
> Cast one asleep; then cut the diseased part."

But we know that none of these procedures, and "not poppy, nor mandragora, nor all the drowsy syrups of the world" were safe, effective and available agents to benumb the senses during a surgical operation.

The history of the events connected with modern surgical anaesthesia begins with the remarkable development of chemistry in the latter part of the eighteenth century, due in large measure to the discovery and study of gases, and especially with the discovery of nitrous oxide by Priestly in 1776 and the investigation of its properties by Humphrey Davy at the end of the century in Dr. Beddoes' "Pneumatic Institute" near Bristol, England. At this period there was widespread interest in England in the study of the effects of inhalation of gases of different sorts, particularly of the newly discovered "vital air," or oxygen and nitrous oxide, and exaggerated ideas were entertained of their medicinal virtues, so that there arose a school of pneumatic medical practitioners. The institute of the leader of this school, Dr. Beddoes, is now chiefly remembered as the place which afforded to Humphrey Davy, then a young man who had commenced the study of medicine, the opportunity for the first manifestations of his remarkable genius for discovery in the physical sciences.

The particular discovery which here concerns us is that of the intoxicating, and especially the anaesthetic, properties of nitrous oxide gas, made in Dr. Beddoes' institute and vividly portrayed by Davy in his "Researches, chemical and physical, chiefly concerning nitrous oxide and its respiration," published in 1799. Here is found the memorable and often quoted sentence: "As nitrous oxide in its extensive operation seems capable of destroying physical pain, it may probably be used with advantage during surgical operations in which no great effusion of blood takes place." It seems to us today amazing that this pregnant suggestion from such a source should have passed unheeded and that the application of Davy's discovery should have been delayed for over forty years. Davy's interests and activities were soon transferred at the Royal Institution to fields remote from practical medicine, and it does not appear that he made any further effort to bring the suggestion to the attention of surgeons.

Observations and tests of the intoxicating effects of the inhalation of nitrous oxide were from this time on frequently made, and there is repeated mention of its capacity to produce insensibility to pain. One of the most dramatic situations, unnoticed hitherto in the voluminous literature on

the history of anaesthesia, is the occasion when, in March, 1800, William Allen, the accomplished lecturer on chemistry at Guy's Hospital, demonstrated, in the presence of Astley Cooper and others, the phenomena of inhalation of nitrous oxide, noting especially the loss of sensation to pain. The description was recorded by Allen in his diary and is quoted by Wilks and Bettany in their "Biographical History of Guy's Hospital." The great surgeon had eyes but he saw not the revelation which a similar observation brought forty-four years later to the poor and unknown dentist, Horace Wells, in Hartford, Conn.

The narcotic properties of ether—a body known since its production in the sixteenth century by the German physician, Valerius Cerdus—had been noted before those of nitrous oxide. In 1795, Dr. Richard Pearson recommended and employed the inhalation of ether in pulmonary consumption, and after him Thornton, John Collins Warren, Nysten and others used etherial inhalation for the relief of painful affections, especially of the respiratory tract, including that caused by the accidental inhalation of chlorine gas. In 1818, Faraday pointed out that the inhalation of the vapor of sulphuric ether produces intoxicating and stupefying effects similar to those of nitrous oxide, and in Pereira's "Materia Medica," a widely read and authoritative text-book in its day, first published in 1839-40, it is stated that "if the air be too strongly impregnated with the ether, stupefaction ensues."

The inebriating properties of both nitrous oxide and ether became widely known, not only to the medical profession, but also to the general public by their frequent exhibition, for amusement oftener than for instruction, in chemical, medical and popular lectures. The thirties and forties of the last century were the palmy days of the itinerant lyceum lecturer. In the laughing gas and ether frolics, associated sometimes with these lectures, and occurring also for private entertainment, an acute observer might note that intoxicated subjects in their antics often barked their shins or were otherwise injured without manifestations of pain. The first trials of anaesthetic inhalation to annul the pain of a surgical operation came from the incidental observation under such circumstances of the benumbing effects of ether and of nitrous oxide gas.

The great French surgeon, Velpeau, doubtless expressed the accepted opinion of surgeons before the discovery of surgical anaesthesia when, in 1839, he wrote: "To escape pain in surgical operations is a chimera which we are not permitted to look for in our day. Knife and pain, in surgery, are two words which never present themselves the one without the other in the minds of patients, and it is necessary for us surgeons to admit their association." In less than a decade this erring prophet hailed before the

Academy of Medicine in Paris the discovery of what he had called a chimera as "a glorious triumph for humanity."

For several years before the invention of anaesthetic inhalation for surgical purposes, considerable popular and some medical interest in the possibility of securing unconsciousness of pain during a surgical operation had been aroused by the claims of the mesmerists, and there seems to be no doubt that Esdaile, in East India, and others, had, in certain cases, succeeded in performing painless operations in hypnotic sleep. The method, however, was not widely applicable or successful, and the general attitude of the profession towards its employment is sufficiently shown by the joy of the eminent surgeon, Liston, the first after the dentist, Robinson, to verify in Great Britain the discovery of surgical anaesthesia, when he shouted, "Hurrah! Rejoice! Mesmerism and its professors have met with a heavy blow and great discouragement. An American dentist has used the inhalation of ether to destroy sensation in his operations and the plan has succeeded in the hands of Warren, Hayward and others, in Boston. In six months no operation will be performed without this previous preparation. Rejoice!"

It has been sometimes represented that the invention of anaesthetic inhalation for surgical purposes consisted in nothing more than the application to this particular use of knowledge which already existed. This view falls far short of the truth. What was known of the anaesthetizing properties of the two agents which here come under consideration—the vapor of ethyl-ether, commonly, although incorrectly called sulphuric ether, and nitrous oxide gas—was enough to suggest the possibility of their use in surgical operations, and, as I have stated, Sir Humphrey Davy published this definite suggestion as early as 1799. Much more knowledge, however, was needed of the physiological effects of these agents in order to demonstrate their applicability as safe, efficacious and generally available surgical anaesthetics. The only possible sources for obtaining this additional knowledge, as well as that which had already been acquired, were experiments upon either animals or man. From both of these sources the desired knowledge was obtained, but with a larger use of experimentation upon man than we should today consider justifiable.

The honor of making the first trial of anaesthetic inhalation in surgical operations belongs to Dr. Crawford W. Long, a respected and honorable country doctor, then living in Jefferson, Jackson County, Ga., who in March, 1842, removed painlessly a small tumor from the neck of James M. Venable, anaesthetized by ether. He seems to have performed at least eight minor surgical operations during the next four years upon patients under the influence of ether. Dr. Long is necessarily deprived of the large

honor which would have been his due had he not delayed publication of his experiments with ether until several years after the universal acceptance of surgical anaesthesia. It is also to be regretted that his published details of the mode of administering the ether and the depth of the anaesthesia are so meager and unsatisfactory. While the accepted rule that scientific discovery dates from publication is a wise one, we need not in this instance withhold from Dr. Long the credit of independent and prior experiment and discovery, but we cannot assign to him any influence upon the historical development of our knowledge of surgical anaesthesia or any share in the introduction to the world at large of the blessings of this matchless discovery.

Until the prior work of Dr. Long became generally known, largely through the publication of an article by Marion Sims in 1877, although the announcement had been made by Long in 1849, and more fully in 1852, the credit of first using inhalation of an effective anaesthetic for surgical purposes was generally assigned to Horace Wells, a dentist of Hartford, Conn. Impelled by the observation of apparent loss of sensation to pain in a person intoxicated with nitrous oxide gas, and exhibited at a lecture by Dr. Gardiner Q. Colton in December, 1844, Wells, the following day, at his own request, submitted to the extraction of a tooth while under the influence of the gas and experienced no pain. He at once began the use of nitrous oxide in extracting teeth, and other dentists in Hartford used it. Desiring to secure larger publicity for his discovery, Dr. Wells went to Boston in January, 1845, and was given the opportunity by Dr. Warren to demonstrate the value of his claims before him and the students, Dr. Morton, his former partner, being also present. Either from the too early withdrawal or the inferior quality of the gas this test was a tragic failure, which exerted such a depressing influence upon Wells that he soon withdrew from his profession, abandoned his experiments and four years later ended his own life under most distressing circumstances. From what we now know of the valuable anaesthetic properties of nitrous oxide, and from contemporary evidence, there is no reason to doubt that Horace Wells painlessly extracted teeth by its use, and that if he had persevered in his efforts, he would have been able to perfect the method of producing anaesthesia by this gas and to demonstrate to the world the art of surgical anaesthesia. While he did not achieve this complete success, the credit which belongs to him is large and the name of Horace Wells should always be held in honored remembrance.

Unlike the pioneer work of Long, that of Wells forms a direct and important link in the chain of discovery which led through the event celebrated here today to the universal adoption of surgical anaesthesia. So far as was

known then and for years afterwards to those concerned in the further development of the subject, Wells was the first to take the step to which the finger of Humphrey Davy had pointed forty-five years before, and the results and claims of Wells were familiar to his friend and former partner, Morton, and must have stimulated the interest of the latter in the possibilities of surgical anaesthesia, although Morton believed that the particular agent used by Wells was not adapted to secure this end.

The significance of the public demonstration of surgical anaesthesia in this hospital sixty-two years ago today does not depend upon the settlement of the bitter controversy between Charles T. Jackson and William Morton concerning their respective shares in this event. I deem it, however, fitting and only historical justice to say that in my judgment, after careful study of the evidence, the greater share of the honor belongs to Morton. This was the prevailing opinion of those most competent to judge and best acquainted with the facts at the time, the trustees and staff of the Massachusetts General Hospital and the leaders of the profession in this city, of such men as John Collins Warren, Jacob Bigelow, James Jackson, Henry J. Bigelow, Oliver Wendell Holmes, George Hayward, Henry I. Bowditch, George Shattuck, Walter Channing, John Ware and many others, although it is only fair to state that the petition in favor of Jackson's claim was headed by the honored name of Morrill Wyman and contained the names of many respected physicians. This opinion has remained, I believe, the prevailing one, not only in this city, but throughout this country. The judgment of the Paris Academy of Sciences in awarding equal honors to Jackson and to Morton established European opinion to a large extent up to the present time.

Morton undoubtedly received helpful suggestions from Jackson, who was a highly-trained and eminent chemist and geologist. It is not wholly clear to what extent these contained information not accessible elsewhere, but the evidence seems conclusive that Morton was indebted to Jackson for valuable information which the latter had acquired by personal experience four years earlier concerning properties of ether, strongly suggesting its availability for surgical anaesthesia; also for suggesting the use of chemically pure rather than commercial ether, and for apparatus for administering the ether. There is, however, good evidence that Morton, while reaching out for all the information and assistance which he could obtain from different sources, acted independently and conducted experiments and tests with ether upon his own initiative and in accordance with his own ideas. The supposition appears to me irreconcilable with the facts that he was merely a hand to execute the thoughts of Jackson.

In the conflict of testimony, there is not likely ever to be entire agreement of opinion concerning the exact measure of Morton's indebtedness to Jackson, but assigning to it all possible weight, and remembering Humphrey Davy had suggested the use of nitrous oxide for surgical anaesthesia in 1799, and that enough was already known of the anaesthetic properties of both ether and nitrous oxide to have led Long, in 1842, to apply the former, and Wells, in 1844, the latter to painless surgery with a considerable measure of success, it seems to me clear that the chief glory belongs not to Jackson's experiences of 1842, or his thought or suggestion, whatever these may have been, but to Morton's deed in demonstrating publicly and convincingly the applicability of anaesthetic inhalation to surgical purposes and under such fortunate circumstances that the knowledge became, as quickly as it could be carried, the blessed possession of the whole world.

There are circumstances in the conduct of Morton as well as of Jackson much to be regretted in connection with this great discovery, and especially is it to be deplored that Morton, the least heroic of great discoverers, should, if only for a short time, have kept secret the nature of his "letheon," and that he and Jackson should have patented it.

Participation in the gift of surgical anaesthesia to the world brought to none of the claimants to this honor any adequate material rewards or fame during their lives, but rather the stings of embittered controversy, resulting in mental derangement in the case of two of the participants. The boon of painless surgery is the greatest gift of American medicine to mankind and one of the most beneficent ever conferred. There is a growing tendency to celebrate the gift with too little thought of the giver. This easy procedure is doubtless due to the difficulty of meting out equal and exact justice to all concerned and to disinclination to stir the ashes of old controversies. This dispositions of the matter, however, is unjust, and it seems to me that every effort should be made to determine the share and the credit belonging to each contributor to the discovery and the introduction of surgical anaesthesia, and to secure, so far as possible, an agreement of opinion in this important matter. We are not likely to come into possession of important new facts, but their unbiased presentation in historical order, and the consideration of their relative values and significance, should clarify professional and public opinion and enable us to give honor where honor is due. One of the most attractive and instructive accounts of the ether controversy is the chapter on this subject in Dr. Mumford's charming "Narrative of Medicine in America," where references will be found to more detailed statements and the historical documents. I have endeavored in this brief and imperfect historical survey incidentally to express in some measure my personal judgment of the relative importance of the leading contributions,

and my conclusions are in essential agreement with those of Dr. Mumford when he says that "time and history are at last placing the honor where it belongs,—with Morton, who for his errors most certainly was punished beyond his deserts." But whatever may be the differences of opinion, one fact of the first historical importance stands and will continue to stand unshaken: the world received the gift of surgical anaesthesia as the immediate and direct result of the convincing, public demonstration of its efficacy in this hospital on the sixteenth of October, 1846.

In the bestowal of honors the name of the eminent surgeon, John Collins Warren, should not be forgotten, who had the courage to subject his patient to unknown risks in the hope, which was far removed from any assurance, that a great blessing was about to be conferred upon suffering humanity. Great indeed was his joy in the fulfilment of this hope.

Turning now from these historical considerations, permit me to direct your attention to certain attributes of the discovery of surgical anaesthesia, and certain lessons to be drawn from it.

It is to be emphasized that this discovery was a triumph of the experimental method, albeit man was made the principal subject of experiment. Animal experimentation played a part, for I see no reason to question, although this has been done, Morton's statements that during the summer of 1846 he successfully anaesthetized dogs and other animals with ether, and that the results of these experiments influenced his trial of the anaesthetic upon human beings. It must, however, be admitted that the production of unconsciousness in man by ether had not been preceded by such numerous and properly conducted experiments on animals as were required to furnish adequate conception of its effects or its possibilities of danger. Such experiments would have yielded knowledge of this character, and we know that at the present time as full information as possible would have been secured from this source before administering to man an agent with unknown possibilities of danger, one indeed in this instance stated in textbooks of the time to be dangerous to life when pushed to the point of producing complete unconsciousness. If the opponents of animal experimentation attempt to utilize, as they have done, the relatively small share of this method of advancing knowledge in the discovery of surgical anaesthesia, the only implication of the argument is that they would substitute experiments upon human beings for those upon animals, for only from one or the other of these sources could the discovery have been derived.

We place, then, the discovery of surgical anaesthesia with such other great discoveries as those of the circulation of the blood, of vaccination against smallpox, of antiseptic surgery, of antitoxin and many more among the great contributions to the welfare of mankind made by the use of that

indispensable aid to the advancement of medical science and art, to wit the experimental method of investigation.

A quite different line of thought suggested by the discovery of surgical anaesthesia is the aid to medicine which comes often in the most unexpected ways from discoveries in other sciences. Not only did chemistry furnish the anaesthetic agents, but the wonderful discoveries of pneumatic chemistry, which revolutionized the whole science of chemistry in the latter part of the eighteenth century, where the immediate stimulus to the study of the physiological effects of various gases, a study which led promptly to the recognition of the anaesthetic properties of nitrous oxide gas, and which, continued through half a century, resulted finally in the demonstration of the applicability of certain of these gases for surgical anaesthesia. Here, as for so many other gifts, medicine owes a large debt to chemistry, as she does likewise to physics, as may be exemplified by the applications of the Roentgen rays in medical and surgical diagnosis.

While, it does not appear to us that the discovery or, as some prefer to say, the invention, of surgical anaesthesia required any remarkable intellectual endowments or high scientific training, and it cannot be said that Long, Wells or Morton were possessed of these, it was the outcome of a spirit of inquiry, of keen observation, of boldness, of perseverance, of resourcefulness, of a search for means to improve a useful art, of interest in the practical rather than the theoretical,—all traits more or less characteristic of the American mind, and I do not think that it was wholly an accident that our country should have given birth to the art of painless surgery. I find evidence of this view in the fact that not one but several Americans were working independently upon the same problem and that the solution of the problem is an exclusive achievement of our countrymen.

The circumstance that a long-awaited discovery or invention has been made by more than one investigator, independently and almost simultaneously, and with varying approach to completeness, is a curious and not always explicable phenomenon familiar in the history of discovery, and, as in the case of surgical anaesthesia, it has been the source of endless and often bitter controversy. Sooner or later, often long after the death of the participants, historical justice has usually come.

The approach to the great discovery is long and devious and marked by the capture of a barrier here and an outpost there; when the fullness of time has come the final assault is often made by more than one person, and the victor stands upon the shoulders of many who have preceded him,—it may be of many who have fallen by the way.

The period when surgical anaesthesia was discovered was one full of the spirit of scientific inquiry and the opening of new paths for medicine.

There had come to be a general realization of the fact that the only trustworthy sources of knowledge are exact observation and experiment. The great impulse derived from the introduction of the new methods of physical diagnosis and the systematic anatomical study of disease had shortly before reached this country from France, and was especially active in this city. Experimental physiology and pharmacology had entered upon fruitful fields of exploration through the work of Magendie and of Johannes Müller and their pupils. The foundations of cellular pathology were soon to be laid. While it is not apparent that those directly concerned in the discovery of surgical anaesthesia were influenced by the new spirit and the new ideas, they contributed an aid to experimental research of immeasurable service. It was fortunate indeed for the pubilc demonstration, reception and promotion of the discovery of surgical anaesthesia that it was revealed to that able group of surgeons and physicians then connected with this hospital, who were imbued with the new scientific spirit and with the best traditions of the profession, and were active in the advancement of the art.

A consideration of some interest connected with the introduction of surgical anaesthesia is the influence of environment and of material conditions upon discovery. Here we find illustrated the fact, of which there are many examples, that apparently adverse surroundings and average intellectual endowment without special scientific training of the highest importance to mankind. The country doctor in Georgia, with only an ordinary general and professional education, and the two poor and previously unknown dentists of Hartford and of Boston, are the chief actors in the drama. It is not surprising that dental surgeons should have been particularly eager in the quest of anaesthesia, for there is no more excruciating agony than the pulling of an aching and sensitive tooth, and the short duration of the operation and the suffering would suggest possibilities of success which might not be variable in a prolonged surgical operation. Nor is it surprising that American dentists should have been most active in this search, when we recall the remarkable inventiveness and skill which have characterized their work and have given to American dentistry a foremost position for this branch of surgery.

On the other hand, however, the share which the Massachusetts General Hospital and its surgeons had in the demonstration, promulgation and acceptance of surgical anaesthesia exemplifies the value of a favorable environment and was laregely responsible for the complete success which Morton achieved over his predecessors in discovery. The manner in which the surgeons of this hospital at that time—including John Collins Warren, George Hayward, Henry J. Bigelow and J. Mason Warren—received and advanced Morton's demonstration of anaesthesia, must always be a source

of pride, not only to this hospital, but to our country and the world. Especially are they to be commended for their insistence upon disclosure of the nature of the secret letheon. No better example can be found of the service which a great hospital and its professional staff can render in furthering discovery and in advancing and spreading new knowledge and new methods important to the medical and surgical art than that furnished by the Massachusetts General Hospital in its relations to the demonstration and introduction of surgical anaesthesia, and its officers and staff have ever remained faithful to the high ideals then exemplified.

Worthy of especial mention are the first announcement to the new world in a scientific journal of the great discovery, by Henry J. Bigelow, in an important paper read before the American Academy of Arts and Sciences, on Nov. 3, 1846, and published in the "Boston Medical and Surgical Journal" on Nov. 18, and likewise Oliver Wendell Holmes' delightful part in coining the word "anaesthesia," and, indeed, his whole attitude of lively, sympathetic and imaginative interest, as expressed in all that he said and wrote concerning the new discovery. A sentence often quoted will suffice to illustrate Dr. Holmes' appreciation of the benefits of the discovery, as well as his powers of vivid description:

"The knife is searching for disease, the pulleys are dragging back dislocated limbs, nature herself is working out the primal curse which doomed the tenderest of her creatures to the sharpest of her trials, but the fierce extremity of suffering has been steeped in the waters of forgetfulness, and the deepest furrow in the knotted brow of agony has been smoothed forever."

The reception of the joyful discovery was everywhere enthusiastic, although not without some of the mutterings which come from those petrified against all innovations, as appears from remarks made by Professor Miller to his class in London not long afterward. "The profession," he says, "were surprised, excited, charmed in the mass, and more especially those on the junior side of the grand climacteric. The elderly gentlemen had their preconceived and heretofore settled notions sadly jostled and disturbed. Not a few grew irritable and resented the interference; they closed their ears, shut their eyes and folded their hands; they refused to touch or in any way meddle with the unhallowed thing; they had quite made up their minds that pain was a necessary evil and must be endured; they scouted on the attempted innovation and croaked that 'no good could come of it.' On, notwithstanding, sped the movement."

One of the most extraordinary aberrations of the human mind was manifested by the raising of religious scruples, particularly against the abolition of pain in childbirth. Sir James Simpson, the discoverer of the anaesthetic uses of chloroform, and of important service in advancing the art of

anaesthesia, quotes from the letter of a clergyman, who declares that chloroform is "a decoy of Satan, apparently offering itself to bless women, but in the end it will harden society and rob God of the deep earnest cries which arise in time of trouble for help." If this clergyman remembered the primal curse, he forgot the earliest example of anaesthesia when, in the resection of a rib for the creation of Eve, "the Lord God caused a deep sleep to fall upon Adam."

The immediate immeasurable benefits conferred by anaesthesia in the relief of human suffering were realized more fully and were expressed more adequately by the generation which knew by experience the contrast between the old surgery and the new painless surgery than is possible for us today. But of all the blessings which were to flow from this priceless gift there could be only a feeble conception sixty years ago, and as this flow is unceasing, we, ourselves, cannot fully estimate them. Anaesthesia and antisepsis, the two greatest boons ever conferred upon the surgical art, have made possible the marvelous developments of surgery during the last forty years, and only by their aid can surgery continue to advance.

I have somewhere seen a statement to the effect that the introduction of anaesthesia and of antisepsis have made the practice of surgery so certain and so easy that qualities of hand and of mind which were essential to high success in the practice of pre-anaesthetic surgery, and which were exhibited by the surgical heroes of old, are no longer necessary, so that even commonplace mortals can now become surgeons. There is perhaps a half truth in this, but it is more than compensated for by the demands upon the skill and judgment of the modern surgeon in the performance of operations vastly more difficult than any which were possible or were dreamt of in the old days.

What surgery was before the days of anaesthesia, and what anaesthesia has done for surgery and for obstetrics, are subjects which were presented at the semi-centennial anniversary of anaesthesia in this hospital by Dr. Ashhurst, Dr. Cheever and Dr. Reynolds, men far more competent to deal with them than I am. On the same occasion I had the privilege of speaking on the influence of anaesthesia upon medical science, and I shall not now consider this aspect of the subject, save to note again in passing that physiology and experimental medicine in their special fields have derived benefits from anaesthesia comparable to those enjoyed by surgery. That the useful knowledge which can come only from experimentation upon animals can now be acquired in by far the larger part part without the infliction of pain is a source of immense satisfaction.

Ushered in by the discovery of vaccination against smallpox at the close of the eighteenth century, the greatest practical achievements in our art

during the nineteenth century were anaesthesia, antiseptic surgery and the power to control infectious diseases resulting from the discovery of their living contagia—achievements surpassing the heritage of all the centuries which had gone before in the saving of human life and the alleviation of suffering. Of all these gifts of medicine to mankind, the sweetest and the happiest is that "death of pain" so beautifully portrayed at the semi-centennial anniversary of anaesthesia by our beloved poet-physician, Wier Mitchell:

> "Whatever triumphs still shall hold the mind,
> Whatever gift shall yet enrich mankind,
> Ah! here no hour shall strike through all the years,
> No hour as sweet, as when hope, doubt, and fears,
> 'Mid deepening stillness, watched one eager brain,
> With Godlike will, decree the Death of Pain."

To these fine lines I can add in closing no more fitting words than those of John Collins Warren, who presided over the scene enacted here sixty-two years ago, a name ever to be honored in this place and throughout the civilized world. These words, spoken soon after the event which we celebrate, retain their vigor, freshness and truth to this day. He said:

"A new era has opened on the operating surgeon. . . . . If Ambrose Paré and Louis and Dessault and Cheselden and Hunter and Cooper could see what our eyes daily witness, how would they long to come among us and perform their exploits once more. And with what fresh vigor does the living surgeon, who is ready to resign the scalpel, grasp it and wish again to go through his career under new auspices. As philanthropists we may well rejoice that we have had an agency, however slight, in conferring on poor suffering humanity so precious a gift. Unrestrained and free as God's own sunshine, it has gone forth to cheer and gladden the earth; it will awaken the gratitude of the present and of all coming generations. The student, who from distant lands or in distant ages, may visit this spot, will view it with increased interest, as he remembers that here was first demonstrated one of the most glorious truths of science."

BIOLOGY AND MEDICINE[1]

It is a great pleasure to bring hearty congratulations to the University and the City of Chicago upon the completion of the Hull Biological Laboratories. This university, the offspring of unexampled private munificence, marvellous in its birth and infancy, and clearly destined to great achievements for education, for science and for humanity, may well rejoice upon this occasion, but Miss Culver, by her beneficent gift, has earned the gratitude not of this university alone, but of all interested in the progress of the biological sciences. A gift of such magnitude as this one, devoted to "the increase and spread of knowledge within the field of the biological sciences" is of far more than any local significance. It must awaken the cordial interest far and near of those who understand the scope and meaning of the sciences of organic nature. What is here planned and has already been accomplished, gives assurance that the wishes of the donor and the expectations of others will be amply fulfilled, and that in these laboratories in unusual measure will knowledge of the forms and activities of living things grow and hence be diffused.

Laboratories are now so universally recognized as essential for the systematic study and advancement of all physical and natural sciences, that we can hardly realize that they are almost wholly the creation of the last three-quarters of the present century. With the awakening of scientific thought in Western Europe in the fifteenth and sixteenth centuries, natural phenomena again began to be studied by those methods of exact observation and experiment which had received their last fruitful application centuries before in the hands of the natural philosophers and physicians of Greece and Alexandria. For the purposes of such study, learned academies and societies were founded, botanical gardens were planted, explorations and collections of natural curiosities were made, apparatus was devised and individual investigators had their scientific workships. All of these material circumstances greatly promoted scientific inquiry and discovery, but with one exception they did not lead to the formation of laboratories freely open to students and investigators. The exception was the establishment of laboratories for the study of human anatomy.

It is of no little interest, both for the history of biology and for that of science in general, that the first laboratory for the training of students was

[1] An address delivered at the Dedication of the Hull Biological Laboratories at the University of Chicago, Chicago, July 2, 1897.

Am. Naturalist, Phila., 1897, XXXI, 755-766.

the anatomical laboratory. For over six hundred years there has been at least some practical instruction in anatomy, and for over three hundred years there have existed anatomical laboratories for students and investigators. Until the end of the first quarter of the present century there was no branch of physical or natural science, with the exception of anatomy, which students could study in the laboratory. Only in this subject could they come into direct personal contact with the object of study, work with their own hands, investigate what lay below the surface, and acquire that living knowledge which alone is of real value in the study of natural science.

The era of modern teaching and investigating laboratories was ushered in by the foundation of one devoted to another of the biological sciences. In 1824 Purkinje established a physiological laboratory in Breslau which antedated by one year Liebig's more famous chemical laboratory in Giessen. This latter, however, which is usually, and, as we have seen, not quite correctly, considered to be the first of modern teaching laboratories, exercised the determining influence upon the establishment and organization of scientific laboratories in general. The significance of Liebig's memorable laboratory is that it provided a place, furnished with the needed facilities and under competent direction, freely open to properly prepared students and investigators for experimental work in the entire field of the science to which it was devoted. Such an impressive illustration of the value of laboratories for instruction and research could not fail to be followed by other departments of science. In this movement for the establishment of laboratories, Germany has been from the beginning the leader, and by their instrumentality she has secured the palm for scientific education and discovery.

We owe especially to Louis Agassiz the introduction into this country, fifty years ago, of laboratory methods in biological study, but it is only within very recent years that nearly the whole field of biology has been represented among us by laboratories worthy of the name. To the small number of suitably equipped biological laboratories existing in this country those whose opening we are assembled to celebrate, make a most notable addition, unsurpassed, I believe, in construction, in equipment, in plan of organization, and in opportunities for scientific work.

Modern laboratories have completely revolutionized during the past half century the material conditions under which scientific work is prosecuted. They have been the great instrument of the unexampled progress of the physical and natural sciences during this period. Their educational value cannot well be overestimated. They impart, or should impart, to the student something of the scientific habit of thought which is no less valuable in daily

life and in other pursuits than in science. At the present day no university can hold even a respectable place in the march of education and progress unless it is provided with suitable scientific laboratories, and it is one of the glories of this university that this conception prevailed and bore fruit at its inception. The establishment and support of good laboratories require large outlays of money, and it is chiefly this requirement which calls for endowments of universities far surpassing anything needed but a few years ago. But the benefits to mankind derived from such endowments outweigh, beyond all computation, the money expended which, as has been truly said, is "a capital placed at a high rate of interest."

One sometimes hears the remark, and it is of course true, that large endowments, palatial buildings, splendid laboratories do not make a university. The breath of life, the vitalizing principle, must come from those, both teachers and students, who work within their walls. If the phenomena of nature could be learned by contemplation and by hearsay, that famous university which consisted of a log with Mark Hopkins at one end and the student at the other, might exist somewhere outside of the imagination. But knowledge of nature is not to be acquired otherwise than by observation and experiment, for which the facilities at the end of a log are somewhat inadequate. The great teachers and investigators are likely to be attracted to those universities where the resources and opportunities for their special work are the most ample.

Laboratories are only workshops; that which is of vital importance is what is done within them. Provision has been made in the Hull Laboratories for the cultivation of all departments of what is ordinarily called biology. The domain of biology embraces all living things, both vegetable and animal. Of vital manifestations it is only some of the mental operations and doings of human beings which the biologist at present excludes from his survey, and even this self-sacrificing curtailment of his province may not be enduring.

The main directions of biological study relate to the forms and anatomical structure, however minute, of living organisms, to their functions or activities, to their developmental history, both individual and ancestral, to their systematic affinities and classification, and to their distribution over the globe in present and in former geological epochs. This vast field of study is far more than can be compassed by one man, however versatile and industrious, or in one laboratory. It necessitates such specialization and subdivision of labor as is represented by these laboratories and by those appointed to conduct the work in them.

All that relates to the vegetable kingdom, whether it be anatomical, physiological or paleontological, is included under botany. The historical development of this science has been far more consistent and symmetrical

than that of animal biology. In the latter the central position is appropriately occupied by zoology in the widest sense. Unfortunately the term zoology has not had the same comprehensive meaning in reference to animals that botany has in reference to plants, but there is a growing tendency, which I am glad to see is here recognized, to include under the designation "zoology" more and more of animal biology, and especially to discard the artificial distinction between zoology and comparative anatomy, a distinction which can be traced historically to the early development and exceptional position of human anatomy, to which I have already alluded. Not less important than the study of organized form and structure, and inseparably intertwined with it, is that of physiology, which concerns itself with the properties and actions of living beings. Subordinate to physiology, but still deserving recognition as a specialized biological science, is physiological chemistry, which is most fruitfully cultivated by one trained both as a chemist and as a biologist, who gives his whole time to the subject. The study of the structure and functions of the nervous system has become so specialized and has such important relations to psychology, that neurology has here received special recognition as a separate department. The same is true of paleontology, which forms a connecting link between biology and geology, and which has shed most valuable light upon fundamental problems concerning the origin and development of animals and plants.

There are some who see in the setting up of all of these divisions and subdivisions of biological science peculiar perils resulting from the severance of natural relations and loss of perspective. This is the familiar cry of the general worker against the specialist, a cry which, however loudly uttered, will not be heeded. Where proper organization exists, I do not share these apprehensions. The principle of specialization and subdivision of labor has been the great factor in scientific progress. Whenever a body of scientific knowledge has reached a stage of development in which its extent is considerable and its problems and the methods of attacking them are special, it is convenient and proper to recognize it as a branch of science whose interests will be best furthered by workers specially trained to its service.

But while conceding to the fullest extent the practical benefits which attend the separate cultivation of different departments of biology, I would even more strongly emphasize the essential unity of the biological sciences. In essence these sciences constitute but one science, and the great service of the word "biology" in its present use is to embody this conception. The fundamental problems everywhere in biology are the same, the determination of the structure and the properties and the laws controlling them of living matter. In whatever department knowledge be gained as to these fundamental questions, it is a contribution to all departments of biology. The

expansion of our knowledge brings closer together all physical and natural sciences, physics with chemistry, and both with biology. It is of incalculable advantage that the surfaces of contact between the different branches of biological study should be kept clearly in view, and that knowledge gained by one should be made readily available for others. Hence it seems to me that the general plan of organization of these laboratories, providing as they do for special development in all proper directions of biological study, while retaining the conception of biology as one science, is eminently wise.

It would be a hopeless task for me to attempt to indicate to you all of the more important questions in which biologists at the present time are especially interested, even if I were myself familiar with them all. They penetrate into all provinces of life and relate to such matters as the complex organization of cells, the problems of heredity and development, the causes of variation in living organisms, the influence of physical and chemical agencies, and in general of environment, upon the behavior of living cells and organisms, the relations of microorganisms to fermentation and disease, the finer architecture of the central nervous system, and countless other themes. An especially interesting and new direction of development, to which the biological department of this university has made important contributions, is the application of the experimental method to the solution of certain morphological problems. From this source we may reasonably expect valuable light to be thrown upon the great problems of development, variation and heredity, and thereby we may acquire a clearer and more accurate insight than we now possess into the factors concerned in organic evolution.

No branch of human knowledge exceeds in interest and importance the study of biology; none has made greater advances during this century of scientific progress; none is of more importance to human welfare; none has more deeply impressed modern philosophic thought. Biology has profoundly influenced man's attitude toward nature and the views as to his own position in the scale of being. It has important bearings upon social and moral questions. With true religion it has no contest, whatever may have been its influence upon dogmatic theology. It reveals the marvellous fitness of organic nature, and it cultivates one of the finest human sentiments, the love of nature. Who but a biologist, who was also a poet, could have sung of the chambered nautilus?

"Year after year beheld the silent toil
That spread his lustrous coil;
Still, as the spiral grew,
He left the past year's dwelling for the new,
Stole with soft step its shining archway through,
Built up its idle door,
Stretched in his last-found home, and knew the old no more."

To those who seek the practical utility of scientific study biology can show its triumphs, but here as elsewhere in science the important discoveries which have found useful applications have been made by the devotees of pure science rather than by those who make technical utility their guiding principle.

No more striking illustration of the practical benefits conferred by biological discoveries can be given than that derived from the investigation of those lowly microorganisms which are partly our friends, the preservers of the very existence of life upon this globe, and in smaller part our enemies, the causes of infectious diseases. It would be a long story should I attempt to rehearse the useful discoveries in this domain; how Pasteur saved the silkworm industries of France by his studies of a microscopic parasite; how agriculture and dairies and industries concerned with fermentative processes have been benefited; how preventive inoculations have saved the lives of thousands of animals; how surgery has been revolutionized by Lister's application of Pasteur's discoveries; how the scientific study of immunity has opened up new vitas in preventive and curative medicine, as exemplified by the antitoxic treatment of diphtheria and preventive inoculations for rabies, which have led to the saving of untold thousands of human lives. All of the money ever expended for the promotion of biological science has been repaid a thousand fold by the useful applications of biological discoveries, and in making this statement in this presence I trust that I shall not be thought for a moment to countenance that Philistine view of science which would estimate its value in money or in immediate practical utility.

I have already had occasion to touch upon another side of biology, which is not at present here provided for and which may not be so familiar to all as a biological science. I refer to pathology or the study of life in its abnormal forms and activities. This is the pure science of medicine as distinguished from the art of healing. It is just as truly a department of biology as is the study of normal life. The relations of pathology to practical medicine are so intimate that the broader conception of this science as a part of biology is not always appreciated. Nevertheless pathology may be cultivated as a science no more subordinated to practical ends than is any other natural science. Its subject matter is any living thing which deviates from the normal condition. Its province is to investigate abnormal structure, disordered function and the causes of these abnormalities. Pathological biology must rest upon a knowledge of normal biology. Between these two great divisions of biology no sharp lines of demarcation can be drawn. The province of one encroaches at many points upon that of the other and they are capable of yielding each other mutual aid.

Although certain directions of pathological study can be followed in a university independently of a medical school, the natural environment of a pathological laboratory is the medical school and hospital, where it can obtain the necessary material for study. Here only can pathology flourish in its entirety.

At the exercises connected with the laying of the corner stones of these laboratories, President Harper uttered these significant words: "In laying these corner stones today we are laying the foundations of a school of medicine, for aside from the distinct work outlined in each department there is that great and important service to be rendered in the establishment of a school of medicine, the chief work of which shall be investigation." It will not therefore be out of place at the dedication of these laboratories if I say a few words concerning their relations to the proposed school of medicine and the need of such a school.

A university is the historical and proper place for the establishment of a medical school. Before there was a school of law at Bologna or of theology at Paris, there was a school of medicine at Salernum. For centuries all that there was of biology was to be found in the medical faculty. The union between medical school and university is of mutual advantage and each receives renown from the other. The distinction of great universities has often rested in no small measure upon their medical faculties, as witness such names as Johannes Müller, Virchow, DuBois-Reymond, Ludwig, Kölliker, to mention only a few biologists. The advantages to the medical school of this union are manifold. Among the more important of these may be mentioned the encouragement of research, the development of the scientific spirit and of university ideals, the proper maintenance of laboratories, contact with other departments of science, economy of organization, and improved methods of instruction. To secure these advantages the union must be a real one. There is no saving grace in merely calling a medical school a department of a university. The medical school must be a vital, integral, coordinate part of the university. It should also be said in this connection that the granting of the doctor's degree is the function of a university and it is a usurpation for it to be assumed by independent medical schools responsible to nobody.

Medical science and art rest upon a knowledge of anatomy and physiology and these latter subjects are included in the special medical studies. But before undertaking these special studies it is in every way desirable that the students should have had a liberal education which includes a fair training in physics, chemistry and general biology with the ability to read French and German. You not only have here all that is requisite for the training preliminary to medical education, but you have in these biological

laboratories the foundation of a medical school and a part of the superstructure. The usefulness of these laboratories, great as it is under existing conditions, would in my judgment be still further enhanced, especially in certain departments, by association with a medical school, and I need not emphasize the enormous value which the medical school would derive from them.

Not only this University but also the City of Chicago by its size and situation offers peculiarly favorable conditions for the foundation of a great medical school such as is here contemplated.

The present state of the science and art of medicine and of medical education renders especially urgent the claims of higher medical education. Medical science has made enormous strides during the last two decades. The present is a period of great and fruitful activity in medicine. New points of view have presented themselves. Problems of the highest importance to science and to humanity are awaiting only suitable opportunity and patient investigation for their solution. Methods of the laboratory are now applied to the practical study of disease for purposes of diagnosis, prognosis and treatment. The practice of the healing art is a far more scientific and rewarding pursuit now than formerly. The great discoveries relating to the agency of microorganisms in the causation of disease have given a firm basis to preventive medicine, which has as yet been able to utilize only a relatively small part of the available knowledge.

To the new conditions medical education has as yet only imperfectly adjusted itself. The great need of our medical schools is the establishment of thoroughly equipped and well-organized laboratories and these require endowments which none in this country possess to any adequate extent and few possess at all.

While the primary aim of a medical school is to train practitioners of medicine and surgery, a great medical school should also advance the science and art of medicine. This art is becoming in increasing degree applied science, and it cannot be fully acquired without training in the biological medical sciences. I think that in a four years medical course, the first two years should be devoted to the study of fundamental medical sciences, such as human anatomy, physiology, physiological chemistry, pharmacology, and pathology, and the last two to strictly professional training in practical medicine, surgery and obstetrics. It is one of the most important problems of medical education to maintain the proper balance between the purely technical training in the medical art and the study of the medical sciences. The cultivators of pure science in this or any other university need have no fear that the introduction of a medical department, organized in accordance with the present state of medical science, and to

meet the existing needs of medical education, will bring any elements unsuited to the highest university ideals.

A suitably endowed medical school united with a university has today in this country unequaled opportunities to achieve success, and to confer a great service upon medicine and upon humanity. The need of such schools is everywhere recognized by the medical profession which would give to their establishment enthusiastic support.

For this purpose you will need large endowments. You will require a hospital with dispensary service. This need not be a very large hospital, but it should be entirely under your control. You will require additional laboratories of pathology, hygiene, pharmacology, and physiological chemistry. The teachers selected should be also investigators and those engaged in the scientific departments should be well paid, so that they can give their whole time to their subjects.

Medical education has not been a favorite object of endowment. Its needs are very imperfectly understood by the community, and our medical schools in the past have for the most part not been such as to encourage their support by private beneficence. But these conditions are changing as witness the names of such benefactors of medical education as Johns Hopkins, Vanderbilt and Mary Garrett.

Every one who has a patriotic pride in seeing this country take its proper place in the great movement forward in medical science and education, would rejoice to see here in connection with this University and in Chicago, such a medical school as I have endeavored to indicate. In no other direction could this University expand with greater promise of usefulness and renown, than in the promotion of the highest medical education. With the unbounded energy and will of this University and of this City, never content with what has been accomplished, however wonderful, but building for the future, it is not too much to say that you could attain something greater and better than has been hitherto achieved.

In conclusion, I desire to express the hope, indeed the conviction, that the Hull Biological Laboratories, which are now open for active work, will fulfil their high promise, will be guided by wisdom, will cherish high ideals, will contribute abundanty to knowledge, will be a center to which students will wander from far and near, will be a fortress of sound biological thought and education.

RELATION OF YALE TO MEDICINE[1]

On this fourth Jubilee of Yale University, speaking, as I trust I may, in behalf of many hundreds of physicians who have received their liberal or professional education in this institution, I bring affectionate greetings to our Alma Mater, and offer our hearty congratulations on this happy anniversary. With all the sons of Yale we join in the prayer of President Stiles: "Peace be within thy walls, O Yale, and prosperity within thy palaces."

Yale is related to medicine most directly through her medical department, but also through all who have studied here and subsequently practised the art or cultivated the science of medicine. The medical school, although the first department added to the college, was not established until over a hundred years after the foundation of the Collegiate School at Saybrook. From the beginning, however, graduates of the college are to be found in the ranks of medical practitioners, and any account of the relation of Yale to medicine would be most incomplete without some consideration of the alumni of the eighteenth century who were physicians. Their history makes a large part of the medical history of Connecticut during the eighteenth century, but it is not limited to this state.

Eighteenth Century

Doubtless the student of universal medical history, who, after tracing the wonderful development of medicine in the century of Harvey, Malpighi, and Sydenham, is engaged in following medical progress through the eighteenth century, marked by such names as those of Boerhaave, Haller, Morgagni, and Hunter, would not turn aside long to note what the physicians of Connecticut or indeed of any part of America were doing at that time. Still the records of these early Yale physicians have the interest which attaches to the beginnings of things which have become important, and for us the special and sympathetic interest which belongs to the annals of family and country.

When the first physicians who had received their collegiate training at Yale appear upon the scene early in the eighteenth century, the state of medicine in this country had not advanced materially beyond the primitive condition of the early colonial days.[1a] We encounter, as in the early history

[1] An address delivered at the Two Hundredth Anniversary of the founding of Yale College, Yale University, New Haven, Conn., October 21, 1901.

Yale M. J., N. Haven, 1901-2, VIII, 127-158.

of medicine everywhere, three classes of medical practitioners: the priest-physician, the regular physician educated and practising according to the recognized standards of the day, and the empiric or charlatan. What Cotton Mather called "the angelical conjunction" of the cure of the soul and of the body was to be found most frequently and in its best type in New England.[2] Here the regular training of physicians was almost wholly by apprenticeship for three or four years to some practitioner of repute. As vividly portrayed by a Connecticut physician:[3] "The candidate 'served his time,' as it was then called, which was divided between the books on the shelf, the skeleton in the closet, the pestle and pill-slab in the back room, roaming the forest and fields for roots and herbs, and following, astride of the colt he was breaking, the horse which was honored with the saddlebags."

Nor was this condition very materially changed during the eighteenth century by the founding of the Medical Departments of the College of Philadelphia (now the University of Pennsylvania), and of King's College (now Columbia) in the decade before the Revolution, and of those of Harvard in 1783 and of Dartmouth in 1797. During this century only two graduates of Yale College (John A. Graham, Y. 1768, and Winthrop Saltonstall, Y. 1793) had received a medical degree in course. The number of students from the New England colonies who resorted to the medical schools of Edinburgh, London, or Leyden was extremely small, much smaller than that from the Middle and Southern colonies.

With the exception of a law passed in New York in 1760, and a similar one in New Jersey in 1772, there was no effective legislative control of medical practice in any of the colonies. Anyone who chose could practise, and the root doctors and Indian doctors of Connecticut had their counterparts elsewhere. More from the sparseness and poverty of the population than from the absence of disease[4] the remuneration from medical practice was so small that the physician often added some other occupation, most frequently agriculture, to the practice of his profession.

There were no hospitals, except pock-houses, and practically no medical organization. There was little opportunity for intercourse and interchange of views between physicians in different parts of the country, so that local peculiarities of practice were more common then than now. The only text-books were European, the most authoritative on medical practice being the works of Sydenham and of Boerhaave, later also of van Swieten, Mead, Huxham, and Cullen. There was no American medical journal until near the end of the eighteenth century.

With two or three exceptions the few original medical publications, mostly short pamphlets, by American physicians before the Revolution,

contained scarcely any personal observations of importance, so that the names of these physicians are remembered today by their reputation among their contemporaries and their influence upon their successors rather than by any actual contributions to medical knowledge.

After this necessarily brief statement concerning some of the conditions of medical practice in the New England colonies, we are better prepared to appreciate the position and work of those graduates of Yale College in the eighteenth century who became physicians.

The course of studies at the college was planned rather for the preliminary training of ministers than of doctors, but it furnished a classical education, which was then more necessary for the study of medical books than it is today. There seems to have been at least some interest in the college in medical knowledge, if one may judge from the title of some of the early theses and from the possession by the college of a human skeleton and "paintings of the human body skin'd," as they are inventoried. President Stiles occasionally delivered a lecture on medicine, and in his recently published "Literary Diary" he gives an interesting outline of one of these lectures, the main headings being: I. Anatomy, II. Pathology, and III. The Methodus medendi (one of the sub-headings here being "Efficacious Medicines but few")—sufficiently comprehensive, it may be said, for a single lecture, even in those days.[5]

The success attained by the Yale physicians of the eighteenth century indicates that the college then, as ever since, supplied its graduates with a training of mind and character adapted to the circumstances of time and place, and fitting them for the work of life in any field.

Mainly by the aid of Professor Dexter's invaluable two volumes of "Biographical Sketches of the Graduates of Yale College" covering the period from 1701 to 1763, and a kind personal communication relating to the remaining classes, I have been able to determine that there were at least 224 Yale graduates in course of the eighteenth century who practised medicine.[6] This figure, which is certainly somewhat below the correct one, is 9.7 per cent of the entire number of bachelors of arts for the same period—a percentage about the same as the corresponding one for the nineteenth century.

Of the seven graduates in arts from the college in the first two decades of the eighteenth century who became medical practitioners, all, with one exception, were also clergymen, and of the seventy-two physicians graduated in arts in the first half of the century nearly one-fourth were clerical, whereas after this there are only a very few names of clerical physicians.

All who are familiar with the early colonial history of New England know what an interesting class the clerical physicians were. Not a few of them were educated, skilful physicians, who ranked among the leading

practitioners and teachers of medicine in their day, while others were, on the medical side, scarcely more than "comforters of the sick," as they were sometimes called, rather than active practitioners. One of the earliest and most celebrated of this class of physicians was the Rev. Thomas Thacher (1620-1678) of Boston, the direct ancestor of our own honored and beloved Latin professor of the same name. His name is preserved in medical annals as that of the author of the first solely medical publication in America, a broadside folio which appeared in Boston in 1677 and is entitled: "A brief rule to guide the common people of New England how to order themselves and theirs in the small pocks or measles."[1]

But of all those who combined the offices of clergyman and physician, not one, from the foundation of the American colonies, attained so high distinction as a physician as Jared Eliot of the class of 1706, who was the first graduate of Yale College to enter upon the practice of medicine. His name is preceded in the triennial catalogue by that of Phineas Fiske of the class of 1704, who was eminent both as a divine and a physician, but whose shorter professional career did not begin until five or six years after that of Eliot.

The name of Jared Eliot is a worthy one to lead the long line of over 2,300 physicians who have received their liberal or professional education at Yale College. The grandson of the Rev. John Eliot, the Apostle to the Indians, he spent his long, two-fold professional life of 54 years in the town of Killingworth (now Clinton) in this state, where he succeeded in the ministerial office his teacher, Abraham Pierson, the first rector of this college. Of fine bodily presence and engaging personality, for many years an influential trustee of Yale College, the library fund of which was started through his bequest, the friend and correspondent of Benjamin Franklin, Bishop (then Dean) Berkeley, and other learned men, a fellow, it is said, of the Royal Society, and recipient of a gold medal from the London Society of Arts, accounted in his day an excellent botanist, chemist and practical and scientific agriculturist, Eliot, as is stated by Dr. James Thacher in his American Medical Biography (1828), "was unquestionably the first physician of his day in Connecticut," and in chronic complaints "he appears to have been more extensively consulted than any other physician in New England, frequently visiting every county of Connecticut, and being often called in Boston and Newport." It is also said of him that "for forty successive years he never omitted preaching either at home or abroad, on the Lord's day." With evidences of such manifold activity one is prepared to accept the statement in his funeral sermon: "Perhaps no man slept so little in his day, and did so much in so great variety."

It is customary to speak of Jared Eliot as "the father of regular medical practice in Connecticut," and when one considers the number of physicians who were trained under him, and that among these were such leaders of profession and successful teachers of medicine as his son-in-law and successor in practice, Benjamin Gale (Yale 1733), and Dr. Jared Potter (Yale 1760), the title seems justly conferred.

Among other clergymen noted in their day as medical practitioners may be mentioned Eliot's classmate, Jonathan Dickinson, the first President of Princeton College, whose paper published in 1740 entitled, "Observations on that terrible disease, vulgarly called the throat distemper," is the first medical publication by a graduate of Yale College, and the third on diphtheria by an American; Benjamin Doolittle, Yale 1716, of Northfield, Mass., "well skilled in two important arts," according to his epitaph; Timothy Collins, of the Class of 1718, traditions of whose practice are still current in Litchfield County; Isaac Browne, of the Class of 1729, an early member of the New Jersey Medical Society, the first state society organized in this country; Moses Bartlett, 1730, the pupil and son-in-law of Phineas Fiske, described on his monument as "a sound and faithful divine, a Physician of Soul and Body," and the father of a son of the same name, graduated in 1763, who was one of the last of the clerical physicians; Dr. John Darbe, of the Class of 1748, who received the honorary degree of M. D. from Dartmouth in 1782, and is the first graduate of Yale College to become Doctor of Medicine; and Manasseh Cutler, Yale 1765, skilled in medicine as well as in many other arts.

The first non-clerical physician in the list of graduates is Jeremiah Miller of the Class of 1709, who settled in New London. He seems, however, to have been more engrossed with other occupations than with medicine, so that Professor Dexter names John Griswold of the Class of 1721, of Norwich, Conn., as "the earliest graduate of the college who devoted himself exclusively to the profession of medicine."

Among the two hundred and more eighteenth-century graduates of Yale whose principal or sole professional occupation was medicine are to be found the names of many physicians whose memories are preserved, and of whose useful lives and faithful service in their calling this college may justly be proud.* Some were among the most influential and widely known medical men of their time and country. Such were Alexander Wolcott (1731), whose scholarly attainments in medicine are attested by the interesting collection of his books still preserved; Benjamin Gale (1733), one of the few pre-Revolutionary American physicians who have left published records of valuable medical observations; Leverett Hubbard (1744), cor-

porator and first president both of the New Haven County Medical Society and of the Connecticut Medical Society, for many years the recognized head of the profession in this city and county; Eneas Munson (1753), successful, able, and learned, one of the longest-lived and most remarkable physicians of his day, the first name in the medical faculty of the Yale Medical Institution; Jared Potter (1760), described by Dr. Bronson as "the most celebrated and popular physician in this state" in the first decade of the nineteenth century; Mason Fitch Cogswell (1780), one of the "Harford wits," before the arrival of Nathan Smith the most distinguished surgeon in this state, whose name has a permanent place in the history of surgery; Eli Todd (1787), the first superintendent of the Retreat for the Insane at Hartford, who is honored by humanitarians and physicians alike as "the first in this country to introduce the more humane methods of care and treatment of the insane;" John Stearns (1789), Professor of Medical Theory and Practice in the College of Physicians and Surgeons, Western District of New York, President of the New York State Medical Society, who has the credit of first calling the attention of the medical profession to the use of ergot in obstetrics, and Thomas Miner (1796), whose ingenious and erudite essays on fevers and other medical subjects, written partly in conjunction with Dr. Tully, attracted wide attention and much comment both in this country and Europe. To those familiar with this period of American medical history, particularly in Connecticut, other names will occur which might with equal propriety be mentioned, did time permit.

Some who belonged to the medical profession are better known as holders of high public office and for their services to their country than as physicians. Of the five medical signers of the Declaration of Independence, two were graduates of Yale, both in the Class of 1747—Oliver Wolcott, Governor of Connecticut, who studied medicine with his brother Alexander, already mentioned, and practised for a short time in Goshen in this state, and Lyman Hall, the first Governor of the independent State of Georgia, where he followed his profession with marked success. Nathan Brownson of the class of 1761, who was Governor of Georgia, a member of the Provincial Congress and of the Continental Congress, and the holder of other high public offices, was likewise a practising physician and was appointed by Congress Deputy Purveyor of Hospitals and later to the charge of the Southern Hospitals in the Revolutionary War.[*]

The importance of the services of Yale graduates as surgeons and surgeon's mates in the French and Indian War and the Revolutionay War is not to be measured only by the passing mention which I find it possible to

give them here. I have found the names of ten graduates[10] who served in a surgical capacity in the former war, headed by the doughty clerical physician, Timothy Collins (1718), the first Yale army surgeon.

In 1776 the General Assembly of Connecticut appointed a committee of eighteen of the leading physicians of the state to examine candidates for the positions of surgeons and surgeons' mates in the Continental Army, and some idea of the standing of Yale graduates then in medical practice in Connecticut may be gained by the facts that this committee was headed by Alexander Wolcott and contained ten graduates of the College.[11]

The earliest Yale graduate who held a commission in the American Revolution was a physician, Joshua Babcock, of the Class of 1724, Major General of the Rhode Island militia. He had walked the hospitals in London in 1730, being the first graduate of the college to study medicine in Europe, and for nearly twenty-five years was an active practitioner in Rhode Island.[12] Mr. Henry P. Johnston's book, "Yale and Her Honor Roll in the American Revolution," gives the records of twenty-three graduates who served as surgeons or surgeon's mates in this war and of six other physicians who were officers in the army.

The first bestowal of the degree of Doctor of Medicine in America was by Yale College in 1723, when Dr. Daniel Turner, a well-known London physician and voluminous medical writer received the honorary degree.[13] The first American medical degree in course was given by the College of Philadelphia, now the University of Pennsylvania, in 1768. The first graduate of Yale College to receive a medical degree in course was John Augustus Graham of the Class of 1768, who was graduated Bachelor of Medicine from Columbia in 1772, and the first to be admitted to the Doctorate of Medicine in course was Winthrop Saltonstall of the Class of 1793, M. D., Columbia, 1796.[14]

There are certain directions in which Yale graduates during the eighteenth century especially contributed to the improvement of medical conditions in this country, an improvement everywhere slow, and well marked only after the revolution.

The Yale physicians of the eighteenth century, with a few not very important exceptions, which I have mentioned in a note,[15] were trained at home and were thrown in unusual degree upon the results of their own experience. While in the main their practice is not known to have differed from that which prevailed at the time, there is evidence of some local peculiarities. There developed early in Connecticut that special interest in the indigenous materia medica, which, transmitted in direct succession from Jared Eliot, through Benjamin Gale, Jared Potter and Eneas Munson, became a dis-

tinguishing characteristic of Eli Ives and William Tully, the professors of materia medica and therapeutics in the Yale Medical Institution in its early years. This contributed to a less violent system of treatment of diseases than was customary in those days. Even in early colonial days a mild treatment of fevers prevailed in New Haven according to Hubbard, who in writing of this town in his History of New England, recorded that: "The gentle conductious aiding of nature hath been found better than sudden and violent means of purgation and otherwise; and blood-letting, though much used in Europe for fevers, especially in the hotter countries, is found deadly in this fever, even almost without exception."[16] In all probability the unusual success achieved by Benjamin Gale and certain other Connecticut physicians in the inoculation and treatment of small pox is to be attributed to the mild, cooling and open treatment which they adopted rather than to the preliminary mercurial treatment to which they ascribed it. These tendencies, for they were only such, did not find, however, their full expression until the appearance of Nathan Smith's work on Typhous [typhoid] Fever in the next century.

Connecticut physicians were pioneers in the work of organization of the medical profession, and in this work graduates of Yale were prominent. The oldest existing medical society in this country is the still active and flourishing Litchfield County Medical Society, founded in 1765, and preceded by only two short-lived voluntary organizations, one in Boston and the other in New York.

The first organized effort on the part of the profession to secure effective legal regulation of medical practice in the colonies was in 1763, when physicians of Norwich, Conn., petitioned the General Court for an act of incorporation, which was, however, not granted. The name of Elisha Tracy of the Class of 1738 appears among the signers of this interesting memorial. This first unsuccessful attempt was the beginning of a series of efforts which, largely through the initiative of the Medical Society of New Haven County, organized in 1784, resulted in the incorporation of the Connecticut Medical Society in 1782. In the meantime state medical societies had been formed in New Jersey (organized in 1766, incorporated in 1790), Massachusetts (1781), Delaware (1789), and New Hampshire (1791).

The charter of the Connecticut Medical Society is, in most respects, an admirable instrument, and, as regards the organization of state medical societies, historically almost as interesting as the famous Connecticut Constitution of 1639. It embodies in a simple and practical fashion democratic and federative principles of organization and government resembling those adopted by the Commonwealth, and remains to this day a model for similar

societies in other states. Of those concerned in the establishment of this society, graduates of Yale were the most active and influential, and they composed over one-third of the charter members. The first president was Dr. Leverett Hubbard (Y. 1744), and upon his death Dr. Eneas Munson (Y. 1753) was chosen his successor and held the office for seven years.[17]

The most noteworthy contribution to medical literature before the revolution by a graduate of Yale was Benjamin Gale's (Y. 1733) "Historical memoirs relating to the practice of inoculation for the small pox, in the British-American provinces, particularly in New England," published in 1765 in the Philosophical Transactions of London. This creditable and historically interesting paper attracted attention both here and abroad, chiefly on account of its advocacy of the mercurial treatment before inoculation.[18] It may here be mentioned that one of the most valuable of the Yale bicentennial publications, the Literary Diary of President Ezra Stiles, edited by Professor Dexter, contains some interesting historical matter upon this subject of mercurial inoculation, as indeed it does relating to a number of other subjects of medical interest.[19]

After the War of Independence we find in American medical writings greater productiveness and originality than before, attributable largely to the increased medical and surgical experience gained during the war and to the higher degree of self-reliance engendered by the political conditions.

The first original separate medical work in this country after the close of the Revolutionary War was the volume published in New Haven in 1788 entitled "Cases and Observations by the Medical Society of New Haven County in the State of Connecticut." This publication, which contains twenty-six papers reporting cases of disease and autopsies, is an event of importance in American medical bibliography, not so much on account of the intrinsic value of the communications, although several are interesting, but because, in evidence of the newly awakened medical life of the young republic, there is collected here for the first time a series of independent, original observations and studies by different American physicians. Nothing of the kind had appeared before in this country. One-third of the contributors to this volume are graduates of Yale.

Nine years later, in 1797, was started the first American medical journal, "The Medical Repository," published in New York, and its projector was the talented and scholarly Elihu Hubbard Smith of the Class of 1786, with whom were associated Dr. Samuel L. Mitchill and Dr. Edward Miller. Dr. Smith, the father of American medical journalism, died much lamented the following year. Although so young, he was physician to the New York Hospital, the editor of several works, and a contributor to liter-

ary periodicals as well as to his own journal, in which his scholarly papers on the plague of Athens and the plague of Syracuse can still be read with pleasure and profit.* The establishment of "The Medical Repository," which was continued until 1824, was of great service in promulgating medical knowledge and stimulating medical thought and writing in this country at the close of the eighteenth and in the early years of the nineteenth centuries.

The graduate of Yale, however, whose published contributions in the eighteenth century are of the greatest permanent value to medicine, was not a physician, but was that useful and versatile man, Noah Webster, of the Class of 1778. Noah Webster is the first epidemiologist which this country has produced. In 1796 he published "A collection of papers on the subject of bilious fevers, prevalent in the United States for a few years past," and in 1799 appeared in two volumes a work, well known to all students of epidemiology, entitled, "A brief history of epidemic and pestilential diseases," which is of unusual interest, and on account of its records and observations of epidemic diseases in this country has an enduring value. There are scattered papers by him on various medical subjects, and one of these buried in "The Medical Repository" (Second Hexade, Vol. ii) should be rescued from forgetfulness. In this critique of Erasmus Darwin's theory of fever Noah Webster gives a well reasoned, clear and definite presentation of that modern theory, associated with Traube's name, which explains febrile elevation of temperature by the retention of heat within the body.

Nineteenth Century

With the turning of the century Yale College, under the guidance of the first President Dwight, passed not only in name but also in spirit from the eighteenth to the nineteenth century. It was transformed from local to a national institution, and it entered upon a new era of expansion in which seeds were planted, destined in the natural course of development to grow into the spreading tree of a university. The first fruit of this new university idea was the establishment of the medical department, some account of which will now engage our attention.

The need at that time of a medical school in this place is apparent from the fact that only eight or nine graduates of the college before the foundation of the medical department in 1810 had received a medical degree in course, although a much larger number had spent a year in study at medical school.

A part of the plan proposed in 1777 by a Committee of the General Assembly to enlarge Yale College, provided a Board of Civilians was added to the corporation, included the establishments of professorships of medicine and law. In the same year Dr. Stiles, before his entrance upon the duties of the

presidency, to which he had been elected, "drafted a plan of a university, particularly describing the law and medical lectures" to be laid before the Committee of the General Assembly.[21] These negotiations were at the time unsuccessful, and when at last in 1792 the closer union between state and college was effected, these early proposals had dropped out of sight.

In two respects the circumstances attending the establishment of the Yale Medical Department are of peculiar interest. The initiative came from within the college and not from without, and the form of union between the college and the Connecticut Medical Society is something unique in the history of medical schools.

The idea of founding a medical department connected with the college unquestionably originated with President Dwight and was a part of his plan for extending the scope and usefulness of the institution. This broad-minded man was, as is well known, much interested in natural science, and he considered in his writings several matters of medical interest. One of the letters in his "Travels in New England and New York" contains an argument, really remarkable in the light of our present knowledge, in support of his conclusion that malaria is caused by minute living organisms.[22]

It is clear from several passages in the autobiographical reminiscences published in Professor Fisher's "Life of Benjamin Silliman" that at the time of Professor Silliman's appointment to the chair of Chemistry and Natural History in 1802, a medical department was definitely contemplated, and that his appointment was regarded as an important step toward that end. The plan had from this time the hearty sympathy and active support of Professor Silliman. "Expecting," as he says, "from the first to be ultimately connected with a medical school in Yale College," he attended both in Philadelphia and in Edinburgh, where he had gone mainly for chemical study, courses of lectures upon anatomy, materia medica, botany, and theory and practice of medicine, coming under the influence of such famous medical teachers as Wistar and Barton in the former city, and James Gregory and John Barclay in the latter.

For centuries the medical departments of universities were the home of all that there was of chemistry and of other branches of natural and physical science, and it is significant that the medical department of this university came into being at the time when Benjamin Silliman had made New Haven the most important center for scientific work and influence in this country. It can hardly be an accidental coincidence that among the graduates of Yale College in the early years of Professor Silliman's teaching are found the names of such men as William Tully, Alexander H. Stevens, who represented medicine at the one hundred and fiftieth anniversary of Yale College, Jonathan Knight, Edward Delafield, John Wagner, Samuel H. Dickson, and

George McClellan, who became physicians and surgeons of national and international fame.

In 1806 the corporation of the college passed a resolution for establishing a medical professorship, and the Rev. Dr. Nathan Strong of Hartford, who introduced the resolution, and Professor Silliman were appointed a committee to examine and report, and to devise means for effecting the object.[32]

It is to be emphasized that the medical department is the direct offspring of Yale College, and was not started, as nearly every other medical school in the country has been, by a group of outside physicians who have subsequently sought connection with a college. Even if there were no other claims, this origin should entitle the Yale Medical School for all time to the fostering care and support of its parent.

In order to understand the occasion for the negotiations which now ensued between the corporation of the college and the Connecticut Medical Society, it is to be borne in mind that this society was possessed, through its charter of 1792, of unusual prerogatives which gave it control of medical education in this state. It was not only an examining and licensing body, which was proper, but also a degree-conferring body, which was decidedly improper and a usurpation of a function which should belong only to a college or university. From the beginning the society had actively exercised all of these functions, and had furthermore made several regulations, which it was empowered to do, regarding medical education.

It was evidently necessary for the college to come to some sort of understanding with the medical society, and to induce it, if possible, to relinquish some of its chartered privileges.

It is not necessary here to enter into the details of these negotiations between the college corporation and the medical society, which extended over three years, especially as these have been fully set forth in a readily accessible paper by Dr. E. K. Hunt,[33] a generous benefactor of the medical school. Suffice it to say that concessions were made on both sides, and that, largely through the efforts of President Dwight and Professor Silliman, representing the college, and of Dr. Eli Ives, representing the medical society, a satisfactory and amicable arrangement was reached, apparently without a great deal of friction, and was embodied in "Articles of Union," which constitute the act creating "The Medical Institution of Yale College," passed by the General Assembly in 1810 at the October session.[34]

This act fixed the number of professors at four ("to include a complete circle of medical science"), the price of the ticket, and the time of examinations; provided for the establishment of a botanical garden,[35] and of collections in anatomy and in materia medica; for a joint committee of an equal number of persons from the medical society and the corporation to nominate professors to be chosen by the corporation, and also for a like joint examin-

ing board, in which the president of the society had the casting vote in case of a tie; repealed the right of the society to grant honorary degrees in medicine, which could thereafter be conferred by the president of the college upon recommendation of the society; provided that each county could send, upon recommendation of the society, a gratuitous student, and fixed the term of medical study for college graduates at two years, and for others at three years, attendance upon a single course of lectures being requisite for the license, and upon two courses for the doctorate.

It is evident from this summary that the Connecticut Medical Society shared to a considerable degree with the college the control of the medical institution. I do not suppose that the college would have entered into this agreement with the medical society had not the circumstances been such as I have mentioned. Nevertheless, this union between the college and the state medical society had at that time distinct advantages, the most important of which was the securing of the active interest of the physicians of the state in the new institution. In general the circumstances connected with the foundation and conduct of most medical schools in this country have not been calculated to secure the interest and sympathy of the great body of the medical profession.

No more competent testimony to the benefits derived from the union which now existed here could be desired than that of Dr. Jonathan Knight, who says in his introductory lecture in 1853 [17]: "The result of this arrangement has been eminently happy; all unpleasant feeling was at once and forever allayed; the members of the society became interested in the school; we have at all times had the benefit of their counsel and support, and it gives me pleasure to state that no instance of disagreement has ever arisen among the members of the board, or between the school and state society; on the contrary, each has regarded the other as a fellow laborer in the endeavor to promote and advance the interest of medical science."

The relation continued harmonious throughout the remaining period of existence of the agreement between the society and the medical school, but with changed conditions the union ceased to be useful and in some ways had become embarrassing, so that in 1884 by mutual consent it was annulled, and the entire control of the school, the official name of which had meantime been changed by the new charter of 1879 to that of "The Medical Department of Yale College," passed into the hands of the University.

The charter of 1810 by its limitation of the number of professors and of the period of undergraduate medical study, and its regulation of other matters better left to the discretion of the college, was an extremely inelastic instrument, and it is not surprising that repeated legislative changes were found necessary. There have been not less than four distinct charters of incorporation of the medical school, and in addition five or six amendatory

acts.[28] The present charter, which seems to be free from the defects of its predecessors, was enacted in 1879.

At the time of its incorporation in 1810 the Medical Institution of Yale College was the sixth medical school in the United States, the others being the Medical Department of the University of Pennsylvania, founded in 1765; the College of Physicians and Surgeons in New York, founded in 1807, but a descendant of the Medical Department of Columbia University, established in 1768; and the Medical Departments of Harvard (1783), of Dartmouth (1797), and of the University of Maryland (1807).[29]

A commodious stone building on Grove Street, erected by Mr. James Hillhouse, was secured for the use of the medical school, and in 1814 this with an adjacent plot of ground was purchased by the aid of a generous donation by the state of twenty thousand dollars, obtained largely through the efforts of Dr. Nathan Smith.[30] This building, which is now South Sheffield Hall, was the location of the medical school until its removal in 1859 to its present site on York Street.

The members of the first faculty of the medical school, appointed in 1812, were in the order of the arrangement of their names in the college catalogue: Eneas Munson, Professor of Materia Medica and Botany; Nathan Smith, Professor of the Theory and Practice of Physic, Surgery and Obstetrics; Eli Ives, Adjunct Professor of Materia Medica and Botany; Benjamin Silliman, Professor of Chemistry and Pharmacy, and Jonathan Knight, Professor of Anatomy.[31]

Dr. Munson, to whom I have already referred, was an octogenarian at the time of his appointment, which was as intended, only an ornamental one, Dr. Ives, the adjunct professor, his pupil and friend performing the active duties of his chair. The remaining members of this faculty made a group of medical teachers who could challenge comparison with any similar group in this country. Of Benjamin Silliman it is not necessary for me to speak further, as his most important work lay outside of the immediate field of medicine, and will be considered by another speaker.

Dr. Nathan Smith, when he came to New Haven from Dartmouth, was already a star of the first magnitude in the medical firmament. Starting a poor boy in a small village in Vermont, he managed by his own efforts to obtain a good general education, and then at the Harvard Medical School and in Great Britain a medical education of a character then almost unknown in New England. He was the originator of the Dartmouth Medical School in 1797, the most distinguished member of the first medical faculty of Yale, and in 1820 the organizer of the Medical Department of Bowdoin College. He did much of his most important work in New Haven, where he remained until his death in 1829.

Nathan Smith shed undying glory upon the Yale Medical School. Famous in his day and generation, he is still more famous today, for he was far ahead of his times, and his reputation, unlike that of so many medical worthies of the past, has steadily increased, as the medical profession has slowly caught up with him. We now see that he did more for the general advancement of medical and surgical practice than any of his predecessors or contemporaries in this country. He was a man of high intellectual and moral qualities, of great originality and untiring energy, an accurate and keen observer, unfettered by traditions and theories, fearless, and above all blessed with an uncommon fund of plain common sense.

Nathan Smith's essay on "Typhous Fever," published in 1824, is like a fresh breeze from the sea amid the dreary and stifling writings of most of his contemporaries. The disease which he here describes is typhoid fever, and never before had the symptoms been so clearly and accurately pictured. He recognized that this fever is due to a specific cause and is self-limited. It took courage in those days for a physician to write, "During the whole course of my practice I have never been satisfied that I have cut short a single case of typhus, which I knew to be such," and again, "It does not follow of course that this disease in all cases requires remedies, or that a patient should necessarily take medicines because he has the disease." To him the lancet was not the "magnum donum Dei" that it was to Benjamin Rush, and he did more to do away with its indiscriminate use than any single man. The treatment which he advocated—cold water, milk, and avoidance of all violent remedies—is practically the same as that now employed, but it was many a day before physicians came to accept Dr. Smith's revolutionary views.

To the surgeon, Nathan Smith's paper on the "Pathology and Treatment of Necrosis" has in course of time become as much of a classic as the essay on "Typhous fever" is to the physician. Here we find the same admirable description of symptoms, and the introduction of methods of treatment which anticipated modern surgery. This is not the occasion, even did time permit, to describe Dr. Smith's achievements in surgery. It must suffice to say that he was the first to perform a number of important surgical operations, and that in this branch, not less than in medicine, he was an innovator and reformer.

Although none of Dr. Smith's colleagues can be placed in the same rank with him as contributors to medical knowledge, they were men of excellent attainments and became distinguished teachers.

Dr. Eli Ives was connected with the medical school until his death in 1861, having succeeded to the professorship of Theory and Practice of Physic upon the death of Dr. Smith in 1829, and becoming emeritus in 1853. He was highly respected physician of large practice in this city. He was widely

known as a botanist, and was credited with the most extensive knowledge of the indigenous materia medica of any man of his day, a taste for which he had acquired from his preceptor, Dr. Munson. His mind was richly stored with facts, and all were impressed with the value of his teachings.

Dr. Jonathan Knight, who was only twenty-three when appointed professor, became one of the most influential men in the medical profession of this country, having been twice president of the American Medical Association. He was transferred to the chair of surgery upon the death of Dr. Hubbard in 1838. Of dignified personal appearance and manner, with well balanced mental powers, and fine literary culture, Dr. Knight has probably never had his superior in any medical school in this country as a finished lecturer. He was an active teacher in the medical school for fifty-one years, dying only a few months before Professor Silliman, the latest survivor of the first medical faculty.

With this able and devoted group of teachers and a class of thirty-three students,[a] the medical school began its work in November, 1813. To follow in detail its history from that day to this would far exceed the limits of this address. I regret that I can do no more than make mention of some of the professors who have passed to the majority: Thomas Hubbard, of necessity an inadequate successor of Dr. Nathan Smith in the chair of surgery, a plain, self-taught man, of whom Dr. Knight says that he filled his position to the time of his death in 1838 "with great and increasing reputation to himself and benefit to the institution"; William Tully, a really remarkable man, of whom I had hoped to say much more, erudite, original, an experimentalist, unrivalled in his knowledge of the materia medica, an extensive contributor to medical literature; Charles Hooker, of good scientific training, who has the great merit of introducing the newer medicine with its methods of physical examination into New Haven, a writer of valuable papers on auscultation and percussion and on physiological subjects; Henry Bronson, scholarly, devoted to antiquarian research, contributor of important papers on medical history and biography; Worthington Hooker, interested in medical education and the improvement of professional organization, a facile writer, widely known as a useful popularizer of natural science; Moses Clark White, for thirty-three years professor of pathology, who taught as early as 1860 the use of the microscope in medicine in this school; Leonard Jacob Sanford, a faithful teacher of anatomy for nearly a quarter of a century, devoted to the interests of the medical school; James Kingsley Thacher, endowed with unusual intellectual powers and capacity for original scientific investigation, eminent as a comparative anatomist, abreast of modern physiology and clinical medicine, whose early removal by death was an irreparable loss to this medical school and to medical and biological science.

While I refrain in general from mention of the names of those who are still living and are faithful and able successors of these distinguished men, I cannot in this connection pass over the name of Dr. Charles Augustus Lindsley, a member of the medical faculty for thirty-seven years and its executive officer for twenty-three years, a devoted teacher and eminent sanitarian.

The period of greatest prosperity of the medical school, until quite recent years, was the first two decades of its existence, in which the average annual attendance of students was between 70 and 80. The annual attendance then fell to an average of between 30 and 40 for the four decades from 1850 to 1890. Since 1895 it has for the first time exceeded 100. Up to 1894 the largest class was that of 1822, which numbered 92, the largest number of graduates in any year up to 1897 being 36 in 1829. Of the 1221 graduates of the medical department up to and including 1900, 27.6 per cent were also college graduates, and of these three-fourths were graduates of Yale College or the Sheffield Scientific School. The highest ratio of college graduates (40.6 per cent) was in the decade 1881 to 1890, when the total number of graduates was smallest.[33]

It is pleasant to recall that the medical department, established through the efforts of the first President Dwight, entered upon a second era of prosperity in the administration of the second President Dwight, who in his annual reports has forcibly presented the needs and the possibilities of this first offspring of the college.

The standards of the Yale Medical School have always been kept high in comparison with those prevailing at the time, and at certain periods the school has taken the lead in movements to improve medical education, which from about the end of the third to the middle of the eighth decades of the past century was in a woeful plight in America.

At the beginning the course of medical lectures here extended through six months, a longer period than obtained at the time in any other medical school in this country.[34]

The first organized effort to raise the standard requirements for medical education in the United States was made by a Convention of Delegates from Medical Societies and Medical Schools which met in Northampton, Massachusetts, in 1827. The Yale Medical School faithfully conformed to the recommendations of this convention and went to the trouble of securing in 1829 from legislature an amendment of its charter whereby the period of medical study was increased to four years for all who were not college graduates, and to three for graduates, and knowledge of Latin and of Natural Philosophy was required for matriculation. The Medical College soon found itself standing almost alone, "faithful among the faithless," and, in order to preserve its own existence, it was compelled after three years to return

to the old order as regards the length of the period of medical study, although it retained the preliminary requirements, which, however, afterward became inoperative, as they were so far above the demands of other colleges.[35]

The inadequacy of the system of didactic lectures for the training of medical students was nowhere in this country earlier recognized than here. In 1855 the course was supplemented by daily recitations, and, as their advantages were realized, they received in the following years greater and greater emphasis, until they in combination with laboratory practice became at least as early as 1867 a distinctive and certainly a valuable feature of the school.

In 1879 the Yale Medical Department placed itself in the front rank, as regards its standards, with only a few companions at that time, by introducing a stated matriculation examination, and a three years' graded course, lengthened in 1896 to four years. Clinical instruction and the recitation and laboratory plan of teaching, which had been early adopted, continued to be the basis of the course. The thoroughness of the training is attested by the unusual success of the graduates of the Yale Medical Department in competitive examinations for positions in the army and in hospitals, and in state board examinations for the license to practise.

With the laboratory building erected in 1893, and the clinical building now in process of construction, the teaching resources of the medical department have been greatly increased, and there is every indication that it has entered on a new era of success and usefulness, but it cannot reach the height of its endeavor or of the position properly belonging to an important department of this great university without a large increase of its present meager endowment.[36] May this increase of its resources before the end of the present decade be a cause for rejoicing at the one hundredth anniversary of the founding of the medical department!

Of the total number of physicians who have received their liberal education at Yale College or at the Sheffield Scientific School, less than one-fifth are graduates of the Yale Medical Department, and it is pertinent to inquire how their Alma Mater has fitted them for their subsequent professional studies. For the great majority and until comparatively recent years this collegiate training was furnished by the old-fashioned classical course,[37] and there can be no question but that this, combined with other influences of college life, gave an excellent discipline of mind and character, but with no peculiar adaptation to the study of medicine.

The advance of medical science and art during the last half century has given ever increasing prominence to the value to the student of medicine of a good practical knowledge of chemistry, physics and general biology. It is to the great credit of this university that this need was first clearly recognized and supplied in this country by the Sheffield Scientific School, which

in 1870 offered well planned courses in these branches of science, announced as intended especially for the preliminary training of prospective medical students. With the establishment of the laboratory of physiological chemistry four years later, the distinctive, premedical biological course was fully organized, and since 1889 this has been open also to students in the academical department. No more convincing testimony to the importance of this new departure in collegiate education is needed than the mere mention of the names of some of those who were graduated from Scientific School in the ten years following the establishment of this course, and who have acquired distinction in medicine or in sciences akin to medicine. Fortunately I cannot illustrate my argument here by the selection of names from those who have passed away, and I trust that it will not be considered invidious if I cite names so familiar to physicians and biologists as those of Prudden, T. H. Russell, Hun, W. B. Platt, Chittenden, Yamagawa, Curtis, Sedgwick, H. L. Taylor, Gilman Thompson, E. B. Wilson, Mitsukuri, H. E. Smith, E. A. Andrews, Ely. Not only has the laboratory of physiological chemistry under the direction of Professor Chittenden been of great service in the preparation of students for the study of medicine, but its contributions to a science of great medical and biological importance are unequalled in number and value in this country and have given it rank with the best laboratories of its kind in the world.[*]

There have been all told not far from 2,300 graduates of Yale in all of its departments (including the medical) who have become physicians, not counting twice the names of those graduated from more than one department. Of the graduates in arts (1702-1897) about 1100 (9 to 10 per cent) have entered the medical profession, the percentage being about the same for the eighteenth and nineteenth centuries, but varying considerably in different years and decades, as appears from data which I have inserted in a note.[*] Especially significant is the fact that from the classes 1822, 1824, 1825, 1826, and 1828, when the medical department was at the height of its early prosperity, the number of graduates in arts who became physicians was 80 per cent above the general percentage for the nineteenth century, and that over 41 per cent of these received their medical degree from Yale Medical School, as against 24 per cent in general for the period since the opening of the medical department. Of the graduates of the Scientific School (1852-1897) at least 193 (9.1 per cent) were later graduates in medicine, 22.3 per cent of these receiving their degree from the Yale Medical Department.

It is of course out of the question to attempt to give here even the most summary account of the more than two thousand Yale physicians of the nineteenth century. Among those no longer living are the names of such famous men as Alexander H. Stevens, Samuel H. Dickson, George McClellan,

Nathan R. Smith, William Power, Alfred Stillé, Samuel St. John, William H. Van Buren, Edmund R. Peaslee, J. Lewis Smith, Daniel G. Brinton, William T. Lusk, and many others deserving of mention did time permit. The graduates of Yale in the medical profession have contributed their full share to the making of the medical history of this country. Over one hundred became professors in medical colleges, especially noteworthy being the number and distinction of those who have been and who are connected with the medical schools in New York City. At least thirty have been presidents of their state medical societies.

In all these two hundred years of her existence men have gone forth from Yale who have adorned the profession of medicine. Among them have been great teachers, leaders who have advanced medical knowledge, improved medical and surgical practice, and raised the standards of professional life and of medical education, men who have served their country in a professional capacity in peace and in war, and many more who have lead the useful lives of general practitioners, honored in their homes and by their colleagues, and contributing to the welfare of the communities where they have lived.

In centuries past the greatest renown of many universities lay in their medical faculties. There have been later times when the conditions of medicine and of medical education made it less fit to enter into the life and ideals of a university. It is not so today. Medicine has now become one of the great departments of biological science with problems and aims worthy of the highest endeavor of any university, surely none the less worthy because they are associated with human interests of the highest importance.

The union of medical school and university should be of mutual benefit. Medicine needs the influences of a university for its highest development, and the usefulness and fame of a university are greatly increased by a strong medical department. There is today no direction of scientific research more productive in results of benefit to mankind and in the increase of useful knowledge than that upon which medicine in these latter years has entered, and there can be no nobler work for a university than the promotion of these studies.

But medical teaching and research can no longer be successfully carried on with the meager appliances of the past. They require large endowments, many well equipped and properly supported laboratories, and a body of well paid teachers thoroughly trained in their special departments. With an ampler supply of such opportunities as these there is every reason to believe that the Yale Medical Department would take that important position in the great forward movement of modern medicine to which its origin, its honorable history, and the fame of this ancient university entitle it. May the next Jubilee find medicine holding this high position in Yale University!

NOTES

1a. For the condition of medicine in the American colonies, and in the United States in their early years, consult James Thacher, "American medical biography," Boston, 1828; John B. Beck, "An historical sketch of the state of medicine in the American colonies," 2d ed., Albany, 1850; Joseph M. Toner, "Contributions to the annals of medical progress and medical education in the United States before and during the War of Independence," Washington, 1874; F. R. Packard, "The history of medicine in the United States," Philadelphia and London, 1901.

2. Cotton Mather. Magnalia Christi Americana, p. 151. London, MDCCII.

It was not uncommon at this time for liberally educated men who were not clergymen to acquire some knowledge and skill in physic. A notable example is that charming character, the younger John Winthrop, Governor of the Connecticut colony, of whom Mather (*op. cit.*, p. 31) says: "Wherever he came, still the Diseased flocked about him, as if the Healing Angel of Bethesda had appeared in the place."

3. Rufus W. Mathewson, M. D., in Proceedings of the Connecticut Medical Society, 1877, p. 137.

4. Michael Wigglesworth (God's Controversy with New England. Written in the time of the great drought, Anno 1662), clergyman, physician and poet, gave rein to his muse in attempting to record his observations and impressions of the sickness prevalent in 1662. These are a sample of his verses:

"New England where for many yeers
You scarcely heard a cough,
And where Physicians had no work,
Now finds them work enough."

There are records of repeated epidemics in the New England colonies of small pox, scarlet fever, measles, scurvy, dysentery, influenza, diphtheria, bilious or autumnal (doubtless typhoid) fever, and yellow fever. Malaria was endemic in many localities whence it later temporarily or permanently disappeared. Consumption and pneumonia were common. Noah Webster. A brief history of epidemic and pestilential diseases. Hartford, 1799. Packard (*op. cit.*) gives a full statement and many references.

5. Among the Commencement Theses for 1718, the earliest of which any printed records remain, is one entitled: "Respiratio necessaria est ad Circulationem Sanguinis continuandam." (Dexter's "Biographical Sketches," Vol. I, p. 179). All but two of the remaining seven theses at this Commencement relate to natural or physical science. Among the theses for 1733 is one entitled: "Motus musculorum ab intrinsica fibrillarum elasticitate oritur."

The anatomical part of the apparatus of the College in 1779 is inventoried in The Literary Diary of Ezra Stiles, edited by Professor Dexter, Vol. II, p. 349.

The divisions of President Stiles' medical lecture are as follows (*ibid*, Vol. III, p. 486): I. Anatomy consisting of 1. Osteology. 2. The arterial & venal or vascular System, with the structure of the Heart & nobler Viscera, & the Harveian Circula of Blood. 3. The Muscles, Tendons & Nerves, & cloathing the whole with flesh. 4. The structure of the pulmonary parts, the Elaboration of Chyle, the Secretions and operations of the abdominal Viscera. 5. The sound and regular State of a healthy Body.

II. Pathology & Diseases or diseased affections of the human Body—chronical or acute. The Seat & Nature & Causes of Diseases, the parts affected internal or external.

III. The Methodus medendi. 1. The materia medica. 2. Chemistry. 3. The Composition of Medicines & their Powers. 4. Their judicious Application—efficacious Medicines but few. Other parts of the Study & Profession, as Surgery & Midwifery—Botany—Books &c.

6. For the period covered by Professor Dexter's two volumes of "Biographical Sketches of the Graduates of Yale College"—1701-1762—I count 120 graduates who practised medicine, the records of three or four of these, however, being so incomplete that the propriety of their inclusion may be questioned. Professor Dexter has kindly informed me that he has counted 104 graduates of the classes from 1763 to 1800 inclusive who became physicians (over two-thirds of whom I have identified without any very thorough or systematic search), but he adds, "I have doubtless left out a number whose records I have never had occasion to fill out." Of these 224 physicians only 27 can be identified by a medical degree (in all but two instances, honorary) in the triennial catalogue.

7. Cotton Mather (*op. cit.*, p. 151), in his life of the Rev. Thomas Thacher says of him: "He that for his lively ministry was justly reckoned among The Angels of the Churches might for his Medical Acquaintances, Experiences and Performances be truly called a Raphael."

8. The authorities which I have found helpful in tracing the records of early Yale physicians are, besides those already mentioned: S. W. Williams, American medical biography, Greenfield, Mass., 1845; the following papers in the Proceedings of the Connecticut Medical Society—G. Sumner, address on the early physicians of Connecticut, 1851; R. Blakeman, Early physicians of Fairfield Co., 1853; A. Woodward, A historical account of the Connecticut Medical Society, 1859, and Brief sketches of the early physicians of Norwich, 1862; C. F. Sumner, The early physicians of Tolland Co., 1871; R. W. Mathewson, Biographical sketches of the original members of the Middlesex County Medical Society, 1877; Francis Bacon, The Connecticut Medical Society—A historical sketch of its first century, 1892; G. W. Russell, An account of early medicine and early medical men in Connecticut. 1892.—also, Henry Bronson, "Medical History and Biography" [From the Papers of the New Haven Colony Historical Society, Vol. II] (These valuable papers, read between Dec. 9, 1872, and Oct. 16, 1876, relate to the history of the Medical Society of New Haven County and the New Haven Medical Association); Francis Bacon. "Some account of the medical profession in New Haven," New York, 1887 (written for "A history of the city of New Haven to the present time, by an association of writers"); S. A. Green, "History of medicine in Massachusetts." A centennial address delivered before the Massachusetts Medical Society in Cambridge, June 7, 1881, Boston, 1881; S. Wickes. "History of medicine in New Jersey, and of its medical men, from the settlement of the province to A. D. 1800." Newark, 1879. Information is to be found also in "The Literary Diary of Ezra Stiles, D. D., LL. D., President of Yale College." Edited by Franklin Bowditch Dexter, M. A. New York, 1901; and in the histories of towns and counties.

The earliest account of a surgical operation by a Yale graduate, which I have found, is of an interesting one by Joseph Perkins of the class of 1727, who invaginated the strangulated part of an umbilical hernia into the healthy intestine. On the 7th day the diseased part was evacuated through the rectum, and the patient recovered (Thacher, *op. cit.*).

9. These examples show that Yale graduates who became physicians had already migrated from Connecticut and had gained distinction in other colonies or States. Of the graduates who practised medicine from the classes 1701-1762 over three-fourths entered College from Connecticut, but only about two-thirds of these remained there in the practice of their profession. Most of the remainder settled in Massachusetts (14), especially the central and western parts of the State, in New York (including Long Island) (11), and in New Jersey (9), but representatives were to be found in most of the other States, there being 5 in the Southern. After this period the ratio of Yale physicians of the 18th century settled outside of Connecticut was doubtless larger, but I have been able to determine the precise figures only for the earlier period covered by Professor Dexter's "Biographical Sketches." The distribution of the physicians probably did not differ materially from that of other graduates of the College.

10. These were Timothy Collins (1718), Israel Ashley (1730), Alexander Wolcott (1731), Joseph Farnsworth (1736), Leverett Hubbard (1744), Elihu Tudor (1750), Gideon Welles (1753), Nathaniel Hubbard (1759), Eliakim Fish (1760), and Ebenezer Jesup (1760). The list is probably incomplete.

11. These were in the order in which their names appear Alexander Wolcott (1731), Eneas Munson (1753), Leverett Hubbard (1744), Elisha Tracy (1738), Benjamin Gale (1733), Eleazar Mather (1738), Platt Townsend (1750), John Clark (1749), Reuben Smith (1757), and Elisha Sill (1754).

12. An account of Joshua Babcock is contained in the "Diary of Ezra Stiles" (*op. cit.*, vol. iii, p. 66).

13. Dr. Daniel Turner was a physician of considerable celebrity, whose biography is to be found in "Biographisches Lexikon der hervorragenden Aerzte," Bd. vi, p. 31, Wien u. Leipzig, 1888, and whose portrait is in the Surgeon-General's Library in Washington. His treatises, "De morbis cutaneis," "Syphilis," and "The Art of Surgery" passed through many editions. He "had accompanied his letters soliciting the honor with a gift of twenty-eight volumes of valuable medical books (some of them written by himself); the circumstance that the degree was thus prefaced led some wit of the period to declare that the mystic letters, "M. D.," must mean "*Multum Donavit*" (Dexter).

The medical degree first conferred in course by the College of Philadelphia was M. B.; the first degree of M. D. in course in this country was granted by King's College (afterward Columbia) in 1770.

Up to 1793 Yale had conferred the honorary degree of M. D. upon seven physicians, two being foreigners: Daniel Turner, 1723, John Bartlett, 1779, George Milne of Aberdeen, 1785, Lewis Dunham, 1787, Charles Kilby, 1789, David Ramsay, 1789, and Isaac Senter, 1792. From 1793 to 1813 inclusive the honorary degree was granted by the Connecticut Medical Society (founded in 1792), and during that time no degree of M. D. was conferred by Yale. With the organization of the Yale Medical Institution the Medical Society by agreement with the College ceased to act independently in conferring degrees, and the College after 1813 frequently conferred the honorary degree of M. D. upon recommendation of the Medical Society. The last degree of this kind was given in 1871. From 1814 to 1871 the College conferred the Hon. M. D. on 161 physicians. These degrees were conferred mostly on members of the Society, rarely on physicians of other States. By the voluntary annulment of the union between the Medical Society and the College in 1884, the charter right to bestow the Degree of Doctor of Medicine reverted to the Society, a right which it is to be expected will never again be

exercised. In the earlier part of the nineteenth century there were many active, well qualified physicians who had never received a medical degree. Historical and other matters relating to the granting of the degree of Hon. M. D. by Yale College and by the Connecticut Medical Society may be found in the Proceedings of the Connecticut Medical Society for 1874 and 1875.

A number of physicians received the honorary degree of M. A. from the College in the eighteenth and nineteenth centuries; the first physician honored by Yale with the degree of LL. D. was Benjamin Rush in 1812.

14. John Augustus Graham was the son of the clerical physician, the Rev. John Graham (Yale, 1740). He practised in Hartford until about 1786, and then removed to New York City, where he continued his work until his death in 1796.

Winthrop Saltonstall after graduation visited Bengal for further medical information and experience, and afterwards settled in practice in Port of Spain, Island of Trinidad, W. I., where he died of yellow fever June 27, 1802, at the age of 27. (Personal communication from Professor Dexter). I suspect that Dr. Saltonstall's visit to Bengal may have had reference to certain matters connected with the fevers of that region discussed in his inaugural dissertation "On the chemical and medical history of septon, azote, or nitrogene; and its combinations with the matter of heat and the principle of acidity," which was published in 1796 and a copy of which is in the Surgeon-General's Library in Washington. This dissertation is based largely upon views advanced in the lectures of his teacher, Professor Samuel L. Mitchill, and for this reason, as well as for the chemical ideas and the peculiar theory of the causation of infectious fevers, it has some historical interest. It is an elaborate and painstaking production.

15. In Professor Dexter's Biographical Sketches of the Graduates from 1702 to 1762 I find that besides Joshua Babcock the following graduates pursued medical studies in Europe: Daniel Lathrop (1733) spent fifteen months in the study of surgery in St. Thomas's Hospital and on his return settled in Norwich, Conn.; Samuel Seabury (1748), Bishop of Conecticut, and the first bishop in the American episcopate, studied medicine for a year in Edinburgh, and practised for a short time in New York; Platt Townsend (1750) "studied medicine, partly in London or Edinburgh, and is said to have practised his profession at one time in Alexandria, Virginia, (where he attended General Washington)"; Daniel Bontecou (1757), "studied medicine in France, and about 1760 received an appointment as surgeon in the French army"; on his return he practised in New Haven; Elihu Tudor (1750) served in a surgical capacity in the British army in the French war, and after the capture of Havana in 1762, at which he was present, he visited England and "availed himself during the two or three years of his residence there of opportunities of hospital service to perfect himself in his profession." He settled in East (now South) Windsor and was accounted one of the best educated and most skilful surgeons of his day, receiving the honorary degree of M. D. from Dartmouth and the Connecticut Medical Society. I have not been able to determine whether any graduates of the remaining classes of the 18th century had the advantage of medical study in Europe. No Yale graduate of that century is credited with a foreign medical degree in the triennial catalogue.

16. Cited from Atwater's History of the Colony of New Haven to its Absorption into Connecticut. New Haven, 1881, p. 370.

17. Of the 61 original members of the Medical Society of New Haven County the following were graduates of Yale College: Leverett Hubbard (1744), whose name stands first in the list, Eneas Munson (1753), Jared Potter (1760), Eneas

Munson, Jr. (1780), Edward Carrington (1767), Obadiah Hotchkiss (1778), John Goodrich (1778), Samuel Darling (1769), Joseph Darling (1777) and Nathan Leavenworth (1778). Dr. Hubbard was the first president and continued in office until 1791, when he was succeeded by Dr. Munson. An interesting historical account of this society with biographies of the County members is given by Dr. Henry Bronson in the collection of papers cited in Note 6.

Among the incorporators of the Connecticut Medical Society are the following Yale graduates: Leverett Hubbard, Joshua Porter, Charles Mather, Josiah Hart, Elihu Tudor, Timothy Rogers, Eliakim Fish, Eneas Munson, Jared Potter, Isaac Knight, Phineas Miller, Jeremiah West, David Sutton, Mason Fitch Cogswell, Thaddeus Betts and John Clark. The papers of Dr. A. Woodward and of Dr. Francis Bacon cited in note 6 give an excellent account of the history of the Society and of many of the early members.

18. Inoculation for small pox was practised in this country first by Dr. Zabdiel Boylston of Boston in June 1721, only two months after its introduction into England by Lady Mary Wortley Montague. Dr. Boyleston was induced to make the trial by the suggestion of the Rev. Cotton Mather, who had read Dr. Woodward's communication on the subject in 1717 to the Royal Society. The practice became the subject of long continued and bitter controversy, in which both the clergy and physicians took an active part, and a large share of pre-Revolutionary medical literature pertains to this subject. John Ely of Saybrook was the first physician in Connecticut who regularly practised inoculation for small pox. The keeping of pock-houses was a source of considerable income to some physicians. Jenner's great discovery, which did away with the practice of inoculation, was made in 1796.

19. According to this account Dr. Muirson of Brookhaven, L. I., in 1731 was the first practitioner in the world to employ the preliminary mercurial treatment (Vol. iii, p. 177). There is much other information in these volumes relating to small pox, inoculation, and the preparatory mercurial treatment, likewise, concerning other diseases, particularly the epidemics of scarlet fever, diphtheria and yellow fever, concerning unusual affections, curious methods of treatment, the practice of midwives, biographies of physicians, etc. There are interesting accounts of two autopsies at which President Stiles was present. Physicians, as well as others, have reason to thank Professor Dexter for undertaking the laborious task of editing this diary, the value of which had already been indicated by published extracts and references.

20. Both Dr. Thacher in his "American Medical Biography" and Dr. Billings in "A Century of American Medicine, 1776-1876," designate Elihu Hubbard Smith as the most active promoter of the establishment of "The Medical Repository." Dr. Smith was a man of many accomplishments. He prefixed a poetic address to his edition of Darwin's Botanical Garden, was the author of Edwin and Angelina, or the Banditti, an Opera in 3 acts, 1797, and the reputed author of André, a Tragedy in 5 Acts, performed in New York, in March, 1798. His letters to William Buel on the Fever which prevailed in New York in 1795 were published in Noah Webster's Collection of papers on the subject of bilious fevers. Seven papers by him are published in the first two volumes of The Medical Repository.

21. A copy of this plan is preserved among Dr. Stiles's papers. "The Literary Diary of Ezra Stiles," Vol. ii, pp. 214, 229, 233, 254; Vol. iii, pp. 8, 452.

22. Timothy Dwight's "Travels in New England and New York," 1821, Letter xxxviii.

23. George P. Fisher's "Life of Benjamin Silliman," Philadelphia. 1866. Vol. i, p. 260.

24. Ebenezer K. Hunt, M. D., Presidential Address on "Public and Benevolent Institutions and Movements, with which the Connecticut Medical Society has been prominently identified." Proceedings of the Connecticut Medical Society. Second Series, Vol. ii. In 1895 the Medical Department received a legacy of $25,000 from Mrs. Hunt, widow of Dr. Hunt, in memory of her husband, whose name is attached to the professorship of anatomy.

25. This Act is entitled "An Act in addition to and alteration of an Act entitled 'An Act to incorporate the Medical Society.'" It was printed in the Proceedings of the Connecticut Medical Society for 1811 (not in the Reprint of the Prcoeedings, 1792-1829, published in 1884).

26. The botanical garden was established on grounds adjacent to the Medical School building on Grove street by the exertions of Prof. Eli Ives and at his own expense. A hot-house was built and a variety of native and foreign plants, shrubs and trees, mostly of a medicinal nature, were planted. Mr. Frederick Pursh, the well known author of "Flora Americae Septentrionalis," was engaged as Curator of the Garden, but he did not enter upon the work on account of a subsequent, more important engagement. At a later period Dr. M. C. Leavenworth, a graduate of the Medical Department in 1817, who was a good botanist, was engaged to make a collection of indigenous plants for the garden, and at one time there was a good collection of such plants. The time and expense involved, however, proved to be burdensome and the garden after a protracted struggle for life perished from neglect. Ebenezer Baldwin's History of Yale College, New Haven, 1841, and Dr. Henry Bronson's Biographical Notice of Dr. Eli Ives in Proceedings and Medical Communications of the Connecticut Medical Society, Ser. 2, Vol. ii, p. 311.

27. Jonathan Knight. A Lecture, introductory to the Course of Lectures in the Medical Institution of Yale College. New Haven, 1853. This lecture is a valuable source of information for the early history of the Medical Institution.

28. In 1818 the professors of the Medical Institution presented to the Medical Society a memorial recommending that the law be changed so that attendance upon two courses of lectures be required before the examination for a license. This recommendation was not adopted.

A. In 1825 the General Assembly passed an Act entitled, "An Act to incorporate the Connecticut Medical Society and to establish the Medical Institution of Yale College." This Act, which repealed that of 1810, was printed in the Proceedings of the Connecticut Medical Society for 1830. The only material change made by it is that the counties can send gratuitous students for only a single course of lectures.

There were three or possibly four amendatory alterations of this Act before its repeal by the Act of 1834. These were: 1. In 1826 "An Act in addition to an Act entitled 'An Act to incorporate the Connecticut Medical Society and to establish the Medical Institution of Yale College.'" This was to legalize an agreement on the part of the professors to pay each for five years annually towards a fund for a Hospital to be established in New Haven one-tenth part of his fees (not to exceed for each professor annually one hundred dollars), on condition that the gratuitous attendance of students be abolished. This change continued in force until 1832, when a return was made to the old rule regarding gratuitous students, and this latter continued in force until 1879, with the proviso adopted in 1856.

2. Professor Simeon Baldwin in his letter to Dr. Carmalt (Proc. Conn. Med. Socy., 1884, p. 12) says that "An Act in addition to and alteration of 'the Act of 1825' was passed in 1827 (Session laws of 1827, p. 235-236)," but I find no other reference to this Act in the Proceedings of the Society, and I have not consulted the Session Laws.

3. In 1829 there was passed "An Act in addition to and alteration of 'the Act of 1825.'" This permitted an increase of the number of professors to six (in force until 1866), established as a preliminary requirement for medical study, "in addition to a good English education, a competent knowledge of the Latin language and some acquaintance with the principles of Natural Philosophy," and lengthened the period of medical study to three years for college graduates and four years for others, but attendance upon only one course of lectures was necessary for the license, and two courses for the degree.

This elevation of the standards was made in order to conform with the recommendations of the Convention of Delegates which met at Northampton in 1827. But while the Yale Medical School adopted these recommendations with much trouble to secure the needed legislation and in good faith, other colleges did not, so that

4. In 1832 the Legislature amended the law so as to return to the old periods of two and three years of study for graduates and non-graduates respectively. The requirements regarding preliminary education remained in force.

B. By the preceding amendatory acts matters had become so mixed that in 1834 a new and separate Act, repealing the former ones, was passed. There were two Acts, one entitled "An Act to incorporate the Connecticut Medical Society," and the other, "An Act in relation to the Medical Institution of Yale College," and this remained in force until 1879. This Act embodied the amendments already in force, and included the requirement of a graduating dissertation (in 1814 the Medical Society had passed a resolution that a dissertation by every student was deemed indispensable), but otherwise the provisions did not differ materially from those of the Act of 1825.

There were two amendments to this Act:

1. In 1856 was passed "An Act in addition to an Act entitled 'An Act in relation to the Medical Institution of Yale College'" providing that "no person shall be recommended .... to a gratuitous course of lectures, unless such person shall have previously attended one course of lectures in the Medical Institution of Yale College."

2. In 1866 an Act amendatory of the Act of 1834 removed the restriction upon the number of professors (which, however, could not be less than four), provided that the price of tickets for each branch should not exceed \$15, fixed the fee for graduation at \$25, and provided for two examinations, one to be at the close of lectures, and the other during commencement week. The Act of 1834, as amended in 1856 and 1866, is printed in the Proc. of the Conn. Med. Soc., Sec. Ser., Vol. ii, Appendix G, p. 106.

C. In January 1879, the Legislature enacted the existing charter. This changed the name of the Institution to The Medical Department of Yale College, did not limit the number of professors, left to the College the determination of the period of medical study and other matters which had been fixed in previous Acts, made no provision for gratuitous students, retained the system of a joint nominating committee and a joint examining committee, but contained the important provision

that by mutual agreement between the College and the Medical Society the union between the two might be annulled without further legislative action "and in that event the management and control of the Medical Department shall devolve solely upon the President and Fellows of Yale College, and upon the Medical Faculty under their direction."

In May, 1884, the union, which had existed for nearly three-quarters of a century, between the Yale Medical Department and the Connecticut Medical Society was by mutual agreement annulled.

29. From 1783 to 1791 the College of Philadelphia and the University of Pennsylvania maintained rival medical schools, but in the latter year they were merged into the Medical Department of the University of Pennsylvania. The Medical Department of Columbia (then King's) College, founded in 1768, was suspended during the Revolutionary War and for some years afterward. It was reorganized in 1792, but there was so much dissatisfaction that in 1807 the College of Physicians and Surgeons was established under the Regents of the University of the State. In 1810 Columbia College discontinued its medical department, and in the following year the College of Physicians and Surgeons became its Medical Department.

In 1812 the Regents incorporated the College of Physicians and Surgeons of the Western District of the State of New York, located in Fairfield, and discontinued in 1840.

N. S. Davis. Contributions to the History of Medical Education and Medical Institutions in the United States of America. 1776-1876. Washington, 1877.

30. "Commons" were instituted in the basement of the building, and above were sleeping and study rooms for the students. The close connection with the College is evidenced by the attempt to introduce into the Medical School academic customs of the former. The medical class assembled morning and evening for prayers, the professors officiating, and the rigid rules governing the academic department were enforced. These academic customs were discontinued in 1824 with the establishment of the Theological and Law Departments. They are probably without parallel in the history of medical schools.

In 1835 and subsequently enlargements and other improvements were made in the medical building, better fitting it for its purposes, especially for anatomical work.

At the beginning a few hundred dollars were advanced by the College Corporation to enable the School to begin its work, but later this sum was refunded. Some of the money donated by the State was used for the purchase of a library, and of collections in anatomy and in materia medica, the last being regarded as the best at that time in this country. The library was increased by a gift of 250 volumes by Dr. Lewis Heerman, a German Navy Surgeon, who, after the death of Dr. Nathan Smith, delivered a few lectures on military surgery.

31. The following changes in the chairs or titles of these first professors were subsequently made: Dr. Munson, in 1820 title changed to Professor of the Institutes of Medicine; Dr. Smith, in 1820 obstetrics dropped from the title of his chair (as printed in the catalogues of that time); Dr. Ives, in 1820 Professor of Materia Medica and Botany and Lecturer on Diseases of Children, 1829, on the death of Dr. Smith, Professor of the Theory and Practice of Physic, 1852 Professor of Materia Medica and Therapeutics, 1853 *Emeritus* until his death in 1861; Dr. Knight, in 1817 Professor of Anatomy and Physiology, 1820 also Lecturer on

Obstetrics until 1829, 1838 Professor of the Principles and Practice of Surgery until his death in 1864.

32. This is the number given by Dr. Jonathan Knight in his Introductory Lecture of 1853. Mr. Baldwin in his History of Yale College states that the number of students was 36. In the Catalogue of the Officers and Students of the Medical Institution of Yale College, November, 1813, the number of medical students is 37. Probably the larger number is explained by accessions to the class.

33. For the eight decades, 1821 to 1900, the average annual attendance of students in the Medical Department was as follows: 1821-1830, 76; 1831-1840, 52; 1841-1850, 47; 1851-1860, 36; 1861-1870, 36; 1871-1880, 38; 1881-1890, 34; 1891-1900, 105. In 1868 was the smallest class, which numbered 23. The greatest depression was in the years 1867 to 1873 (average 27), and 1879 to 1889, the latter being attributed to the elevation of the standards. The class now (1901) numbers 145.

The total numbers of graduates in the decades from 1814 to 1900 inclusive are as follows, the percentages of those with a liberal degree being in parentheses. 1814-1820, 62 (32.3 per cent); 1821-1830, 229 (19.3 per cent); 1831-1840, 169 (26.6 per cent); 1841-1850, 152 (26¼ per cent); 1851-1860, 119 (20.2 per cent); 1861-1870, 125 (23.2 per cent); 1871-1880, 98 (33.7 per cent); 1881-1890, 64 (40.6 per cent); 891-1900, 203 (37.9 per cent). 20.6 per cent of these 1221 graduates of the Medical Department are also graduates of Yale College or the Sheffield Scientific School—17.1 per cent being from the former and 3.5 per cent from the latter.

Among the more distinguished graduates of the Medical Department who are no longer living and were not connected with it as teachers may be especially mentioned Jared P. Kirtland, John Locke, James Gates Percival, Nathan R. Smith, Samuel McClellan, Edward E. Phelps, Ashbel Smith, Joel E. Hawley, Henry D. Bulkley, Levi Ives, Edmund R. Peaslee, Abner H. Brown. This list might be much extended. At least sixty graduates of the Medical School have been officially connected with it as teachers, fifteen of these being professors, viz., Charles Hooker, Henry Bronson, Pliny A. Jewett, Charles A. Lindsley, Francis Bacon, Moses C. White, Lucian S. Wilcox, Thomas H. Russell, James K. Thacher, Samuel W. Williston, Oliver T. Osborne, Henry L. Swain, Benjamin A. Cheney, Harry B. Ferris, and Charles J. Bartlett. Eleven have served as Instructors, eight as Lecturers, and twenty-six as Assistants, not counting twice the names of those who have held more than one of these positions.

34. The length of the annual course was afterward shortened to five months, then to four months (1824). In 1832 it was from the second week in November to the last week in February. It is now 34 weeks, exclusive of vacations.

35. See Note 28, amendatory Acts of 1829 and 1832.

In 1867 a convention of delegates from medical colleges, which assembled in Cincinnati, issued a circular recommending various reforms in medical education. To this the Yale Medical School, through a Committee of its Faculty composed of Drs. S. G. Hubbard and M. C. White, replied expressing sympathy with the efforts and readiness to accept the recommendations as soon as they were adopted and adhered to by other colleges. The committee called attention to the experience of the College in 1829 in acting upon similar recommendations (Proc. of the Conn. Med. Society, Second Series, Vol. iii, Appendix D. p. 28, New Haven, 1871).

36. The endowment of the Medical School in 1900 was only a little over $100,000. Grounds near the hospital have been purchased, where it is hoped that new

laboratory buildings will be erected as soon as the necessary funds are provided, those for anatomy and pathology being urgently needed. The largest salary paid to anyone giving his whole time to teaching is only $2000. The self-sacrificing, enthusiastic devotion of those who have given their services to the Medical School through many years in the face of many discouraging circumstances is beyond all praise.

In 1887 the Alumni Association of the Yale Medical Department was founded and has been a useful, active organization. In 1894 the very creditable "Yale Medical Journal" was started, and is conducted by students with the cooperation of an advisory board.

37. Beginning in 1835 the Professor of Anatomy in the Medical Department gave to the Senior Class in the College in the summer term a course of about fifteen illustrated lectures on anatomy and physiology. These were useful as part of a general education, but of course were not intended to have any bearing upon the study of medicine.

38. The fourth volume of "Studies," issued as a bicentennial publication from the Laboratory of Physiological Chemistry, contains a bibliography of the Laboratory from its commencement in 1875 until the end of 1900. This bibliography gives the titles of ninety scientific monographs and papers.

Contributions of medical interest have come also from the laboratories of Professors Brewer, Verrill, Johnson, Smith and Hastings.

39. Before 1810 the great majority of the graduates of the College who practised medicine were without a medical degree and cannot be identified without further information in the triennial catalogue (see Notes 6 and 8). The records of secondary degrees in this catalogue, moreover, are not altogether complete, so that I have been unable to determine precisely the number of physicians graduated from the College and the Scientific School, but the figures given in the text cannot, I think, be far out of the way. The data for the years 1810 to 1890 are the most accurate. The percentages of graduates in arts who received a medical degree in course for this period are as follows: 1811-1820, 7.6; 1821-1830, 12; 1831-1840, 10.5; 1841-1850, 8.1; 1851-1860, 8.2; 1861-1870, 9.8; 1871-1880, 10.3; 1881-1890, 9.1. The highest percentages of physicians for individual classes are in the eighteenth century, for example 35.3 for 1750, and between 20 and 25 per cent for 1747, 1749, 1753, 1754 and 1760, but then the classes were so small, that it is hardly proper to use percentages. I have spoken in the text of the high percentages for classes in the third decade of the nineteenth century, the highest being 19.1 for the class of 1824. Other notable percentages are 18.8 for 1833, 17.9 for 1852, 13.8 for 1860, 12 for 1862, 18.9 for 1864; 15.3 for 1888. The influence of the civil war in increasing the number of physicians is apparent in the foregoing statistics. Of the graduates in arts who subsequently became doctors of medicine in course 40 per cent from the classes 1813-1840 received their medical degree from the Yale Medical Department, whereas the corresponding percentages for the three decades 1841-1870, and the two decades 1871-1890, are are respectively 20 and 11.

Of the graduates of the Scientific School 8.7 per cent from the classes 1852-1870 became physicians, and 11.3 per cent from the classes 1871-1890, notably high percentages being 17 for the class of 1883, 16.7 for 1877, 16.5 for 1888.

OPENING REMARKS BEFORE THE ASSOCIATION OF AMERICAN PHYSICIANS[1]

Even if there were any temptation to deviate from the salutary custom of most of my predecessors in this office and to inflict upon you an address of a general character on this occasion, a glance at our full programme would make clear the cruelty of such a proceeding. The insertion from year to year at the beginning of our programme of an "Address by the President" must be intended mainly for decorative effect.

We are here to listen to papers which bring actual contributions to medical knowledge and to discuss them.

It is true that when it is recalled that this is the first meeting of our association in the new century, and that it is just fifteen years since we first met, one is tempted to cast a look before and after; but any attempt at such a retrospect and outlook would lead so far that it does not seem worth while to take up this theme, and perhaps most of the thoughts suggested by it are obvious enough.

Before I fully realized the importance of encroaching as little as possible upon the time devoted to the scientific work of the association, I had in mind certain subjects which seemed appropriate for an address, and to one of these lines of thought it may not be out of place to refer in these opening remarks, although it must be without elaboration.

It would, I think, be of interest to compare the opportunities at present afforded in this country for the training and careers of those who intend to take up as their life-work one of the medical sciences, such as anatomy, physiology, and pathology, with the opportunities open to those who desire to fit themselves for the higher positions in clinical medicine or surgery.

We now have in this country far from enough, but still a fair number, of well-equipped and properly organized laboratories representative of each of the fundamental medical sciences, and I venture to say that in these the thoroughness of laboratory training for students compares favorably with that provided anywhere in the world. In astonishingly few years the laboratory side of our teaching has advanced in several of our institutions from the weakest to the strongest feature of the medical curriculum.

[1] Remarks of the president made at the opening of the Association of American Physicians, Washington, D. C., April 30, 1901.

Tr. Ass. Am. Physicians, Phila., 1901, XVI, [minutes], pp. XVI-XXII.

But what I wish now to emphasize is not the undergraduate instruction, but rather the facts that a young man who chooses for his career one of the scientific subjects can find in several places in this country the opportunities and training to make him a good anatomist, physiologist, or pathologist, and if he succeeds in winning his spurs he can look forward with reasonable assurance to securing a desirable position as a teacher and a director of a laboratory of his special branch of science. He must serve his apprenticeship as an assistant for five, ten or more years, the conditions being much like those for promotion in the German universities.

All of this is a gratifying advance over former conditions. It is true that we are only at the beginning of this direction of development, but the path has been opened and entered upon, and the lines of advance are clearly marked out.

Now, how is it with similar opportunities for the far larger number of young physicians who wish to fit themselves for corresponding careers in clinical medicine and surgery? In general the only path open to them is through family practice and work in a dispensary, supplemented, perhaps, by some laboratory work. While this may lead to the desired end, it does not seem to me the method adapted to secure the best results. In two respects there is a striking contrast between these conditions and those which prevail in the making of anatomists, physiologists, and pathologists, viz.: in the opportunities and methods for thorough and prolonged scientific training and in the chances of promotion.

With one or two exceptions our hospitals do not offer the requisite opportunities to young men who aim at the higher careers in clinical medicine and surgery. Over the ordinary internes there should be salaried resident positions of greater permanence and responsibility to enable promising young men to do scientific work, to acquire thorough clinical experience, and to begin to establish their reputations by contributions to their special departments of knowledge. During this period, which should be one of productive work, their positions would be analogous to those of assistants in laboratories, and, as in the latter case, should bring to the front those of demonstrated ability. The reorganization of the medical staff of the hospital necessitated by the change suggested should, moreover, increase its practical and scientific efficiency.

Furthermore, with the present organization of our medical schools and hospitals there is but little chance that a clinician who has acquired a high reputation in one place by his scientific work in medicine or surgery will be called to a vacant position elsewhere; whereas, our medical schools now

look the country over to find the best man available to fill a vacancy in the chairs of anatomy, physiology, or pathology.

It would seem, then, that the training of physicians and surgeons has not kept pace with the progress of medical science to the same degree as has that of specialists in the more purely scientific branches. I should like to discuss this subject more fully, as I am fully aware of the controversial points raised; but before such a body of physicians and pathologists as this it may suffice to have drawn attention to a matter which, although not new, seems to me of an importance not fully and generally recognized.

There is one point more personal to the immediate interests of this association to which I must refer, although it has been repeatedly touched upon by my predecessors. This is the pressure upon our doors for admission by a large number of active workers in clinical medicine, pathology, and bacteriology, many of whom would make desirable members. It does not seem to me expedient to extend further, at least for the present, the limit of membership.

As was said by Dr. Delafield, our first president, in his opening remarks: "We want an association composed of members, each one of whom is able to contribute something real to common stock of knowledge, and where he who reads such a contribution feels sure of a discriminating audience." It is important for the maintenance of these standards that those members who are unable to attend the meetings with some degree of regularity, or to make occasional contributions, either of papers or to the discussions, should realize the congestion of our ranks and the consequent exclusion of desirable men seeking admission. If all to be recommended by the council should be elected at this meeting the limit of membership will be reached.

In this connection I should like to echo a suggestion made by a former president, the lamented Dr. Da Costa, who in discussing this matter said: "The question I ask to present to you is, Whether we could not make a freer use of our honorary list and transfer to it those who have been members for a long time, but find it inconvenient to attend with regularity, yet wish to remain with us? By so doing there would be a larger number of vacancies on our active list." This suggestion seems to me well worthy of consideration.

We have rarely met without our flag at half-mast on account of the death of some of our members, but never before have we had to mourn losses so great as those which we have sustained since our last meeting. During this period there have passed away one of our honorary members and four of the founders of this association, including three of its former presidents—

Stillé, Whittaker, Da Costa, Busey, and Draper. These were honored leaders in our profession, influential teachers, distinguished practitioners and consultants, active contributors to medical knowledge, and faithful and zealous friends of this association. It is not a little remarkable that all belonged to the group of humanists who have adorned so much our profession by their scholarly attainments, and whose active interests extend beyond the domain of medicine to literature, science, and art. The record of their lives and achievements is so well known to the medical world, and especially so familiar to all of us, that I need not enter into biographical details, and the words of tribute and characterization must through lack of time necessarily be few.

Alfred Stillé (1813-1900), who was one of our seven original honorary members, belonged to that interesting group of American pupils of Louis who, bringing back the scientific spirit and the methods of their master, introduced the new medicine in Boston, New York, Philadelphia, and Baltimore during the fourth decade of the past century. But he did not go empty-handed to Paris, for this young physician, fresh from service in Gerhard's wards in the Philadelphia Hospital, made known in France, in a paper read before the Société Médicale d'Observation in 1838, the important observations of Gerhard which established the distinction between typhoid fever and typhus fever. Stillé was a teacher of medicine for forty years, holding for twenty years the Professorship of the Theory and Practice of Medicine in the University of Pennsylvania. His views on medical education were enlightened and, indeed, in some respects, in advance of the time their publication. He was a close and accurate clinical observer, a thoughtful and laborious student, a physician of high ideals, deservedly honored by his colleagues throughout his long and useful life. Of his many publications there may be mentioned as of special importance his standard treatise on "Therapeutics and Materia Medica," which passed through four editions and was translated into German; "The National Dispensatory" by Stillé and Maisch, a work of great service to physicians as well as to pharmacists; and his valuable monograph on "Epidemic Meningitis," which serves as a good example of his scholarly method, clear and finished style, and precise observation. As physician, writer, and teacher, Alfred Stillé has a secure position in the annals of American medicine.

James T. Whittaker was stricken with a fatal disease in the fulness of his powers, and the wish expressed in his Christmas story, "Exiled for Lèse Majesté." "Anyone would prefer to go before his opinions are as petrified as his arteries," was amply fulfilled for him. He was endowed with unusual

energy, enthusiasm, optimism, and an unswerving devotion to his life-work. He was always among the first to seize and apply important new ideas in medicine, as was well illustrated by his hastening to Berlin to study with Koch immediately after the announcement of the discovery of the tubercle bacillus, and by the prompt and interesting reports which he made upon his subject, as well as by his later studies on the use of tuberculin. From the date of the publication of his prize essay in 1870 on "The Morbid Anatomy of the Placenta" up to his final illness he published many and valuable contributions. We shall miss sadly his participation in our meetings.

What need I say before this association of Jacob M. Da Costa? We were proud of him as the brighest ornament of the medical profession of this country, whose fame was world-wide and will endure throughout the annals of American medicine. He will be remembered not only as a teacher, an author, a diagnostician, and consultant of great excellence, but also as a man of rare gifts of character, of culture, and of personal charm. His originality and powers of accurate observation and keen analysis were early exhibited in his studies of cancer of the pancreas, and still more strikingly a little later by his studies on the heart of soldiers in the civil war, which led to his epochal work "On Strain and Over-action of the Heart." Of his publications, all of value, he is best known by his text-book on "Medical Diagnosis," which has passed through nine editions and been translated into several foreign languages, having achieved the greatest success of any American text-book. I need not recall with what delight and instruction we listened to Dr. Da Costa in these meetings, the last of which he attended a year ago. His unexpected death came as a shock to all. He has left a record of high achievement and an example of the best type of physician and man.

It is peculiarly fitting that words of appreciation of Samuel C. Busey should be uttered in this city, where his long professional life was spent, and where he will be long remembered both as a physician and a public-spirited citizen. He was a man of dominant personality, of lofty ideals, of broad views, of untiring industry, and of unusual organizing ability. He did not begin to publish until his forty-first year, when he had acquired a ripe experience. There followed 163 distinct contributions to medical literature, the most numerous and important relating to obstetrics and diseases of women and children. Especially noteworthy are his papers and monographs on diseases of the lymph-channels and on the unjustifiability of craniotomy upon the living fetus. The history of medical legislation and of sanitation in the District of Columbia is inseparably connected with the

name of Dr. Busey. What he says in his charming autobiographical souvenir is true: "I have uniformly contended for the honor and dignity of the medical profession, which I have believed could be more effectively maintained by the dicta of a high *esprit de corps* than by the penal provisions of a code of ethics but rarely enforced; that the highest standard of medical education was demanded by every consideration of professional duty and obligation, and that the profession should assert its prerogatives of right and power, in that legislators and all others in authority should come to know that science must dominate public opinion in all matters pertaining to preventive and remedial medicine." During the last six years of his life Dr. Busey was physically disabled as the result of an unfortunate accident, and he then found solace in literary pursuits which led to the publication of historical and biographical works of much interest and value. Not only this community but the whole nation owe to Dr. Busey a debt of gratitude for his public services to the national capital.

Only yesterday was borne to his last resting-place one of the most universally esteemed and loved of our members—William H. Draper. Of singularly attractive personality, graceful and dignified in speech and bearing, scholarly in attainments, he was one whom his colleagues always delighted to have as their representative on important public occasions, and upon whom our choice naturally fell to preside over this association at that first notable Congress of American Physicians and Surgeons. In hospital and in private practice he was the successful and beloved physician, whose loss is now deeply mourned by many to whom he had ministered in sickness. His more immediate interests were in clinical medicine, to which he made valuable contributions, especially on the subjects of thermometry, gout, disorders of nutrition, and dietetics; but he was generously appreciative of all good work in medicine, and as president of the Alumni Association of the College of Physicians and Surgeons and as trustee of Columbia University he did much to foster the development of laboratories and of scientific work in that institution. He was deeply interested in the welfare of this association, by whose members he will always be held in affectionate remembrance.

In turning now to the scientific work of the association, permit me to call attention to the large number of papers upon our programme. It will be possible to complete the reading of all the papers only by brevity on the part of the readers and the participants in the discussions. I shall feel called upon to enforce strictly the time limits prescribed by our by-laws, and I must ask that extension of time be not requested. May I make the

suggestion that a paper in the shape most suitable for publication is not always in the form best adapted for presentation to an audience, and especially that historical matter, detailed clinical records, and protocols of experiments can often be omitted, or at least very much abbreviated, to the advantage both of the reader and of the hearers? There is abundant promise in the subjects on our programme and in the names of those who are to present them that we shall be rewarded by an instructive and successful meeting.

THE ORIGIN AND AIMS OF THE NEW SECTION OF PHYSIOLOGY AND EXPERIMENTAL MEDICINE[1]

As this is the first meeting of the newly established section of Physiology and Experimental Medicine of this association it is appropriate to say something concerning its origin and purposes. Those who were most active in directing the recent efforts, which find their first full expression at its present session, to increase the usefulness of the American Association for the Advancement of Science by making it more broadly and authoritatively representative of science in America, naturally desired that the science of medicine should not be without some representation in this important and far-reaching scheme. It is not necessary on this occasion to urge the claims of medical science to such recognition or to do more than point to the history and achievements of the "Versammlung Deutscher Naturforscher und Aertze" as an example of the mutual benefits to be derived from such association of medicine with other sciences. One point, however, may be emphasized in this connection. In this country and under our form of government the interests of science are peculiarly dependent upon public opinion, and it is therefore important that this opinion should be properly informed and directed. There are occasions when the voice of science should be forcibly uttered in a way calculated to influence governmental authorities and the general public. This association, by its large membership, nationally representative character and wide scope is fitted to express in an impressive manner accepted scientific opinion, and it may be important for medicine, for science and for the public welfare that medical science should be represented in the councils of the association.

The determination of the precise way in which medicine should be brought into organic relation with the Association for the Advancement of Science is attended with certain obvious difficulties, and the existing solution of this problem is, I think, to be regarded only as partial and tentative. The plan of organization of the association suggests, if it does not require, the formation of a permanent, separate section representative of medicine in some of its scientific aspects. There has therefore been added to the previously constituted sections a tenth one designated as the "Section of Physi-

[1] An address delivered before the Section of Physiology and Experimental Medicine, American Association for the Advancement of Science, Washington, D. C., December 29, 1902.

Proc. Am. Ass. Adv. Sc., Wash., 1903, LII, 529-534.

ology and Experimental Medicine," a title broad enough to include all but the purely clinical branches of medicine.

If this new section is to hold separate annual sessions with the association for the reading of papers, the question at once arises whether there is any need for what will be practically a new national medical society, and whether it can secure the active support of those whom it is desirable to interest in its work. Many of us think that the limit of human endurance has about been reached in the way of formation of local and national societies devoted to medicine in its general or in its special aspects, and under such circumstances whoever adds to the existing burdens of this kind assumes a grave responsibility.

Another consideration is that the efforts to secure the meeting with the association during convocation week of the various national societies devoted to the fundamental medical sciences have, at least on the present occasion, met with almost complete success. It has, therefore, been decided at present to regard the meetings of these societies as a substitute for special scientific sessions of this section of the association, and certainly no programme which could be arranged for the section could rival in interest and value the combined programmes of the American Physiological Society, the Association of American Anatomists, and the Society of American Bacteriologists, with which may be associated such kindred subjects as anthropology, psychology, microscopy and morphology, also represented by special societies. The only separate meeting of the section at present designed is that for the address of the chairman, with which I think it would be well to combine on this occasion some discussion by the members upon the future policy of this section.

An essential part of the plan thus briefly outlined is that the chairman of the section, being by virtue of his office one of the vice-presidents of the association, and the secretary become members of the council of the association, and thus secure what is important and especially desired—the representation of medicine in the deliberations and action of the council.

It is evident from what has been said that the organization of this section has proceeded only so far as the path seemed clearly marked out, and that the opportunity is open for future developments along whatever lines may seem best to the members with the approval of the council. It is possible that it may be deemed expedient to adhere for some time to the present rather limited plan of organization, but I should hope and expect that a seed has here been sown capable of richer fruitage than this plan now contemplated.

As regards our future policy, I may be permitted to make one or two suggestions. For the success of the section it seems to me most desirable to

secure so far as possible the interest and support of the existing national societies which represent the fundamental medical sciences, as anatomy, physiology, pathology, bacteriology, and hygiene. These societies of course will not, nor is it desirable that they should, relinquish their independence, but they will greatly aid this section, and I think find it advantageous to themselves by continuing to meet as often as convenient during convocation week at the same place with the Association for the Advancement of Science.

A most important question seems to me to be whether after all the section may not be made more useful by representing some aspects of medical science not already provided for by existing societies. There has been a surprisingly large increase in the membership of the association during the past year by the prompt response to circular letters sent to members of the medical profession calling attention to the establishment of the new medical section and inviting application for membership. A large proportion of these new medical members are practising physicians who are not likely to become connected with any of the special affiliated societies. While they will doubtless find much to interest and instruct them in the proceedings of the association and of its sections, and in the meetings of the various affiliated societies, as well as in the columns of the weekly journal "Science," they may, I think, reasonably expect to find under the shelter of the section devoted especially to medical science something more nourishing than the annual address of the chairman.

The idea has suggested itself to me that this section might become a useful and influential body by representing the science of medicine in a broad, as distinguished from a narrowly specialistic sense, with particular emphasis upon the unity of medical knowledge, upon the correlation of the various special medical sciences and upon the relations of medicine to other sciences. Specialization has been undoubtedly the great instrument of modern scientific discovery, nor would I be understood to decry it, but it is attended with certain generally recognized dangers, and, as I have already indicated, there is no necessity of making further provision for societies devoted to the specialized medical sciences.

The medical section of this association would seem to be the proper place for the realization of the conception which I have suggested, and upon the basis of this idea I believe that attractive programmes could be arranged. For example, under the auspices of this section there might be occasionally joint meetings of certain sections and affiliated societies for the combined discussion of subjects of mutual interest to medical and other sciences, and communications of importance to medicine embodying the results of investigations in any field of science would be appropriate and welcome. Then

advantage could be taken of opportunities here offered, which are not enjoyed by any other medical society in this country, of meeting with investigators in all the sciences of nature and of man. I need not here pause to specify the many points of contact between the science of medicine and other sciences. It would certainly be stimulating and profitable to hear at first hand and authoritatively from the physicist, the chemist, the engineer, the zoologist, the botanist, the anthropologist, the embryologist, the psychologist, the results of investigations which bear upon medicine, and on the other hand there are many medical researches of which the reports would interest workers in other sciences.

There are so many subjects which could be illuminated and furthered by their joint discussion by medical men and other scientists that I cite almost at random such examples as the participation of physicists in a consideration of the scientific and practical applications of the Roentgen rays, and Becquerel rays, of chemists in similar applications of physical chemistry to physiology and medicine, of zoologists in questions relating to animal parasites and the spread of certain infectious diseases by mosquitoes and other insects, of botanists in many problems relating to bacteria, of embryologists and biologists in many medical questions pertaining to fundamental properties of the cells, of psychologists in the consideration of nervous phenomena, normal and abnormal, of sociologists in discussing diseases of occupations and certain problems relating to preventive medicine, of engineers with reference to bacteriological and hygienic problems connected with the important subjects of water-supply and sewage-disposal. Doubtless other equally pertinent examples will occur to you, but I have said enough, I trust, to make clear my general ideas upon this subject. My purpose now is simply to point out for your consideration that there are fields, not already pre-empted by existing societies, which this section with industry and wise management may cultivate with good prospect of a rich harvest.

I shall not in this address follow this topic further, as it seems to me better to leave to the deliberation of the officers and members of this section and of the council of the association the detailed elaboration of this plan or of any other plan which may be suggested, if it should be deemed wise to extend the scope and work of the section. Whatever scheme is adopted it should be sufficiently elastic to permit development along those lines which time and experience clearly indicate as the most advantageous.[2]

[2] [The remainder of Dr. Welch's address was extemporaneous, and he informs the Secretary that he has not been able since its delivery to write it out. It was devoted to a consideration of "the relation of medical science to other sciences."]

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE[1]

Ladies and Gentlemen.—In behalf of the members of the association, of our guests and all here present, I wish to express to you, President Schurman and Mayor Almy, our very cordial appreciation of the words of welcome which you have given us. This is the first meeting of the association in Ithaca. It is also a renewal of an old custom of holding a midsummer meeting and I do not know where that renewal, somewhat experimental, of the old custom could be inaugurated under more favorable conditions than in this place. Where could this association feel more at home than here at this home of learning and of science? It must, I think, be a satisfaction to the members at Cornell University to be enabled to show to their fellow members in this association the splendid opportunities which exist and the evidences of the great work done here, and it is equally a pleasure and source of profit to us to enjoy this privilege. We know that this is one of the great and leading universities of the country; that, when it was founded, Cornell University was enabled to do a work that was highly distinctive and significant and which marked a great advance in higher education in America, and that this position of leadership it has never lost. It is a great delight to come at this time of the year to this charming town and enjoy the wonderful beauties of nature in this region. They appeal not only to lovers of science, but to lovers of nature as well, and it would seem that the study of natural history must be stimulated by such surroundings as exist here. So, I say, we are particularly fortunate in coming to Ithaca and to Cornell University at this time.

The American Association for the Advancement of Science has had a very useful and honorable history. At the time it was founded and for many years afterward it was possible for a single association to represent in a very definite and concrete way all the existing natural and physical science in this country. During this period the scientific activities of the country were represented more adequately and comprehensively in this association than in any other body. But as time went on, science in its various branches extended and grew, conditions changed, and it became evident that it was necessary for the association to adjust itself to those

[1] Report of an address, as president, delivered in response to the address of welcome at the 56th meeting of the American Association for the Advancement of Science, Ithaca, New York, June 29, 1906.

Proc. Am. Ass. Adv. Sc., Wash., 1906-07, LVI-LVII, 320-323.

new conditions, the main one being the specialization of scientific work. That specialization has been a great instrumentality in the progress of science throughout the world, but nevertheless it has certain disadvantages and even dangers of its own. I believe that the highest function of this association is to try to minimize to the greatest possible extent the dangers that may arise from the minute subdivision of scientific research. As its name implies, this association represents a central body for the advancement, and, it may be added, the diffusion and the organization of science in America. It may be at times a little burdensome for active workers in one department of science to feel interested in the central organization, but I conceive it to be their highest duty to do so. They should consider the interests of science as a whole in this country, as well as those of their particular branch of science, for unless the whole tree of science flourishes the branches will suffer.

This association represents, as it were, an association of various special scientific societies, perhaps more than an association of various scientific workers. It is necessary to have this coordination of societies in order to bring together the great body of scientific workers throughout the country, but in the plan of our organization the affiliated societies in no sense lose their autonomy and it is essential that they should not. The centers of scientific activity in this country are not concentrated in a few points, as in most European countries, and it is believed that this plan of organization best meets the special conditions of science in America.

It is very important, under our form of government, that there should be a central authoritative voice which speaks for science. How many questions there are, as has been suggested by President Schurman, relating to the highest welfare of society which can be solved only by science, and how important it is that workers in kindred subjects should be brought into contact with each other! There are matters of education, matters of public policy and matters of research in all departments of the government and of national life that sustain very close relations to the opinions of scientific men, and it is, therefore, of first importance that there should be a body which can express in an authoritative and representative way the scientific opinion of the country.

This experiment of renewing the midsummer meeting indicates in a measure the great growth in membership and in influence of this association. In so doing, of course there is no intention of abandoning the meetings in the winter. It was necessary in bringing about a proper adjustment of the work and aims of the association to the specialization of science as represented in the various affiliated societies, to adopt the plan of a winter meeting, but the association while gaining much undoubtedly lost some-

thing by it. Certain members desirable to have with us, were unable to attend, and the more popular side of the work may have suffered somewhat because of the more special and technical character of the papers presented at the meetings in the winter. There are many, such as school teachers, amateurs and others intelligently interested in natural and physical science, but not actively engaged in research, whose support and interest it is desirable that the association should secure and who formerly attended the summer meetings. It is to be hoped that this effort to renew that kind of work and influence of the association which was expressed in the old days by the midsummer meeting will be successful and this extension of influence can be secured without any impairment of strictly scientific aims. As I have said, we certainly could not inaugurate the movement under better conditions than at this time and in this place.

This is the first opportunity that I have had to appear in my official capacity before the association, and I wish to express my appreciation of the distinguished honor which was conferred on me at the meeting in New Orleans. The honor is not merely a personal one, but I interpret it as a recognition of medical science as an integral, coordinate part of the natural science of this country; and medical science, in my judgment, fully merits this recognition on account of the paths which it has opened up and followed and the great advance which it has made in recent years.

President Schurman has indicated to us the intimate relations which science sustains to the highest interests of society throughout the world. and this condition has been brought about largely through scientific discoveries and their application to useful purposes. It is the glory of medicine that in these later days it has been able to contribute its share, a share not unworthy of its rank among the sciences of man and of nature, toward the advancement of useful knowledge. It has done so partly by recognizing the fact that a large part of medical science is essentially biological science, and that this is not only true of normal anatomy and physiology, but that pathology, the science of disordered structure and function, may be considered and cultivated to a large extent as biological science. This has been one of the reasons for the great advance in medicine. The scientific method, the method of observation, experiment and reasoning, in contrast with the dogmatism, speculation and reliance on authority which for centuries dominated the history of medicine, is recognized today by medicine as fully as by any science as the only source of fruitful progress.

But above all, it has been discoveries resulting from the opening up of new paths of investigation which have impressed both the scientific and the popular mind with the importance of medical science. In the last three decades medicine has advanced to a position where it stands as never before

in the very closest relations to the highest interests of human society. When you consider the vast accumulations of population in cities, the great industrial activities of modern times, the efforts to colonize and to reclaim for civilization tropical countries and waste lands, such a stupendous undertaking as the digging of the Panama Canal, all dependent in a very direct manner upon our power to control the spread of epidemic and endemic diseases, and that this power has come from the discovery of parasitic micro-organisms and the study of their properties and of the manner of propagation of agents of infection, it must be clear to you that medicine, especially preventive medicine, is most intimately related to the progress of civilization and the advancement of human society. So the time has fully come for medical science to stand side by side with other sciences and to be represented with them in this association.

I was expected on this occasion not to make a formal address but simply to reply to the cordial words of welcome which have been extended to us on behalf of the university and of the city. The evil day, fortunately for you and for me, seems by the plan of organization to be put far off, when the incoming president is expected to make his formal address to the association.

I now have the pleasure in declaring this fifty-sixth session of the American Association for the Advancement of Science open, and I trust that the sessions of the association and the meetings of the several sections and affiliated societies will be full of interest and profit to all in attendance.

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SOME OF THE CONDITIONS WHICH HAVE INFLUENCED THE DEVELOPMENT OF AMERICAN MEDICINE, ESPECIALLY DURING THE LAST CENTURY[1]

I esteem it a privilege and honor upon this auspicious occasion, in behalf of my fellow alumni, to bring our affectionate greetings and hearty felicitations to our *alma mater* in medicine upon the completion of a century of unbroken, vigorous life and of memorable service in medical education. As I read our history we could, with propriety, commemorate a much longer existence by virtue of the union with Columbia University and as the direct descendants of the medical school of Kings College, founded in 1767, but we need to unravel no tangled skeins of history—how tangled we have just heard from Dr. Curtis—in celebrating the centennial anniversary of the institution which most of the graduates know best under the name of the College of Physicians and Surgeons of New York.

The thoughts which this anniversary brings first to the mind of each of us who are graduates of this college doubtless relate to his own personal experiences when a student within its walls. The reminiscences of very few go back to the Crosby Street days, of many to the Twenty-third Street school, and of still more to the college in its present location. To me, and to many others, of the days of the seventies, come back in vivid memory the old Twenty-third Street building, even then outgrown, and our teachers, Parker, Clark, Dalton, Detmold, Markoe, St. John, Thomas, Sands, Sabine, Draper, Agnew, Seguin, Otis, among those who are gone, and of those fortunately with us, Jacobi, Edward Curtis, McLane, Chandler, Delafield, John Curtis, McBurney, Weir, and Lefferts, all of whom we hold in grateful remembrance. Among these are names of many illustrious in the history of the college and of American medicine—Williard Parker, for over forty years a notable figure in the college and the city; Alonzo Clark, the year of whose birth is also that of the college, the leading consultant of the city, a charming, polished, and withal forceful lecturer; John Dalton, the first of American physiologists, the embodiment of scientific spirit and method, a direct, clear and most attractive teacher; Gaillard Thomas, gifted as man and teacher, widely influential as an author and practitioner, and honored in our profession; Henry B. Sands, full of enthusiasm and energy, a dis-

[1] An address delivered at the Centennial Celebration of the College of Physicians and Surgeons, Columbia University, New York, June 11, 1907.

Johns Hopkins Hosp. Bull., Balt., 1908, XIX, 33-40.

tinguished operator and contributor to surgery; Cornelius R. Agnew, the accomplished ophthalmologist and leader in works of public benevolence, and others whose names might, with equal propriety, be singled out from this roll of honor, but they are all familiar to you.

Fortunate circumstances brought me then, and later, especially under the personal influence of Jacobi, Thomas, Seguin, Sabine, and Delafield, from whom I received an abiding stimulus and inspiration. The college work which profited me most and which I recall with the greatest satisfaction was that of prosector to the chair of anatomy, which brought me into close association with Sabine and the demonstrators of anatomy, John Curtis and McBurney, and which afforded excellent practical training. Francis Delafield and Edward Janeway, a distinguished alumnus of this college, awakened at this time my interest in pathological anatomy. The preparation of my graduating thesis, under the advice of Sabine, was a valuable educational task, which familiarized me with medical bibliography.

One can decry the system of those days—the inadequate preliminary requirements, the short courses, the faulty arrangement of the curriculum, the dominance of the didactic lecture, the meager appliances for demonstrative and practical instruction—but the results were better than the system. The College of Physicians and Surgeons stood then, as it has always stood, in the front rank of American medical schools. Our teachers were men of fine character, devoted to the duties of their chairs, they inspired us with enthusiasm, interest in our studies and hard work, and they imparted to us sound traditions of our profession; nor did they send us forth so utterly ignorant and unfitted for professional work as those born of the present, greatly improved methods of training and opportunities for practical study are sometimes wont to suppose. Clinical and demonstrative teaching for undergraduates already existed and was rapidly expanding in those days, but the experience of a hospital interneship was then, as it still is, almost a necessity to complete the education of a physician before beginning practice. Of laboratory training there was none.

We all rejoice in the splendid, material advancement of the college in the last two decades, in the integral union with Columbia University, in the generous gifts of benefactors, in this fine home, in the excellent laboratories, in the Sloane Maternity Hospital, in the Vanderbilt Clinic, and in the work of teachers and of those taught under these improved conditions and enlarged resources, but many of us cherish fond memories of simpler days, of teachers as able and devoted as their worthy successors, and of fellow students as zealous as those of the present day.

While I could not refrain from recalling these student days and paying grateful homage to our teachers, I realize that this occasion calls for a

broader outlook than merely personal reminiscences and that matters pertaining to the history of the college belong to the theme of Dr. Curtis's address. I trust that I shall not encroach upon his territory in asking your attention to a consideration, necessarily brief and inadequate, of some of the conditions of American medicine at the time of the foundation of this college and shortly preceding it, and of some of the developments since that period.

The century of life of this college comprises in time more than one-third of the medical history of this country and in amount of progress far more than this fraction. The conditions which influenced the development of American medicine before the nineteenth century were mainly such as were determined by the material, political and social circumstances of the country.

The small beginnings of our medical annals belong to that splendid century which saw the birth of experimental science, the century of Shakespeare, Milton, and Molière in literature, of Bacon, Descartes and Locke in philosophy, of Kepler, Galileo and Newton in physical science, and of Harvey, Malpighi and Sydenham in medicine. What could seem more remote, more untouched by these brilliant achievements than the Thomas Wottons and Samuel Fullers and the little band of their successors who ministered in their feeble way to the bodily ills of the settlers scattered sparsely along the Atlantic coast! Yet we do well to cherish the memories of our medical pioneers, negligible though they be in the world's history of medicine, for their story has the interest which attaches to the origin of things which have become important.

It is pleasing to find that the leading cultivators of the natural history of the new world during the colonial period were physicians and that such men as Clayton, Mitchill, Colden, Garden, Kuhn, and of a somewhat later period Hosack, Barton, Wistar, Bigelow, and Torrey have been commemorated by genera of plants named after them. From this interest came a number of contributions to the vegetable materia medica. Here it may be recalled that in its early days there were connected as teachers with the College of Physicians and Surgeons, Samuel Latham Mitchill, David Hosack, and John Torrey, with whom was associated as pupil and collaborator, Asa Gray, all names of importance in the botanical history of this country. The story of Hosack's Elgin Botanic Garden is a familiar one to the members of Columbia University.

In illustration of the influence which the study of prevailing epidemic diseases has always exerted upon the development of medicine, it is interesting to note that the only substantial, permanent contributions to medical knowledge, made by American physicians before the end of the eighteenth

century, pertained to the three great epidemic diseases which in succession sorely afflicted the colonies, namely: smallpox, by Zabdiel Boylston; diphtheria, by Peter Middleton, Richard Bayley and, above all, Samuel Bard; and yellow fever, by Lining, Matthew Carey, Currie, Rush, and others. William Currie's "Historical account of the climates and diseases of the United States" and Noah Webster's "Brief history of epidemic and pestilential diseases" are of permanent value and were both published in this country before the end of the eighteenth century.

While the first American medical classic is John Morgan's "Discourse on the institution of medical schools in America," delivered in 1765, there appeared only six years later the second one—Samuel Bard's "Enquiry into the nature, cause, and cure of *angina suffocativa* or sore throat distemper, as it is commonly called by the inhabitants of this city and colony"—deserving a place beside Elisha North's treatise on spotted fever (1811), and Nathan Smith's essay on "Typhous fever" (1824).

Samuel Bard, the leader in the foundation of the medical school of Kings College, its first professor of the theory and practice of physic, later its dean and the second president of the College of Physicians and Surgeons. second only to Rush in distinction among American physicians of his day, stands in the same paternal relation to the establishment of the first medical school in New York that Morgan and Shippen hold to that founded two years earlier in Philadelphia, and John Warren to the Harvard Medical School started in 1783. Bard's address at Kings College commencement, in 1768, in which he forcibly advocated the establishment of a hospital, seems to have been hardly less notable and effective than the introductory discourse of his friend and fellow student in Edinburgh, John Morgan. Dr. Walter James has recently published in the "Columbia University Quarterly" (March, 1907) an interesting account of the life and services of his eminent predecessor of one hundred and forty years ago in the chair of medicine.

Although during the quarter of a century preceding the Revolution, American medicine had received the seeds of a fresher life planted by such men as Bond, Shippen, Morgan, Bard, Jones, and the remarkable group of physicians in Charleston (Chalmers, Bull, Moultrie, Lining and Garden), the great stimulus to further development came from the increased medical and surgical experience gained during the War of Independence, the contact with better trained and more skilful foreign surgeons and the higher degree of self-reliance engendered by the new political conditions. Evidence of the growing independence of the new generation was the establishment, in 1797, by the scholarly Elihu Hubbard Smith, in conjunction with Samuel Latham Mitchill and Edward Miller—the two latter

important members of the first faculty of this college—of the first American medical periodical—"The New York Medical Repository," which served for many years as the chief medium of publication of medical papers in this country and survived until four years after the foundation in 1820 of the "Philadelphia Journal of the Medical and Physical Sciences," which, in 1827 became the still vigorous "American Journal of the Medical Sciences." Through these three journals can be traced the records of the greater part of America's valuable contributions to medicine.

When the curtain lifted upon the opening of the College of Physicians and Surgeons, in 1807, many already famous, or destined to honor in the annals of American medicine, were upon the stage. Benjamin Rush, taken all in all the greatest figure in American medicine and the sole American representative of the eighteenth-century type of medical philosopher and systematist, died in harness six years later. The colleagues of Rush in the medical faculty of the University of Pennsylvania at this time form a group of unusual distinction—William Shippen, one of the founders of the school and the Nestor of the faculty; Caspar Wistar, the pioneer of the systematic study of anatomy in America, beloved and of enduring fame; Benjamin Smith Barton, eminent as teacher and cultivator of natural science; Philip Syng Physick, a favorite pupil of John Hunter, the best trained and most influential American surgeon of his generation, and his nephew and adjunct professor, John Syng Dorsey, whose promising career was not cut short without a record of brilliant achievement. John Redman Coxe, William P. Dewees, Nathaniel Chapman, and Joseph Parrish, soon to be connected with the university, were already active in the profession; John Redman, the most prominent physician of Philadelphia in his day, the preceptor of Morgan, Rush, Wistar, and many others, was still living in his eighty-fifth year when the College of Physicians and Surgeons was founded.

Nathan Smith, more modern in spirit than Rush and more beneficial in his influence upon medicine to whom the lancet was not Rush's *magnum donum Dei,* had founded the Dartmouth Medical School, in 1798, and later was to become the founder of the medical schools of Yale and of Bowdoin. The versatile and accomplished William Gibson, of delightful memory, was about this time a favorite pupil of Charles Bell and Astley Cooper in London. John Warren of revolutionary fame was at the height of his influence and his greater son, John Collins Warren, and James Jackson had begun their professional careers in Boston. Jacob Bigelow, the most original medical thinker whom this country has produced, had graduated from Harvard College.

The most picturesque and typically American group of physicians and surgeons at the time of the foundation of our college, and for some time

later, was that of the frontier near the banks of the Ohio, the representatives in our profession of the indomitable courage, resourcefulness and native vigor of mind and body of the pioneers who blazed the path for civilization across the continent. The best of these men were, withal, abreast in knowledge, training, and skill with their contemporaries of the Atlantic coast; they were men of striking originality, substantial contributors to the sum of medical knowledge and art, powerful influences in the material, as well as the medical development of what was then the far west. Ephraim McDowell had been in practice in Kentucky for fourteen years when he performed the first ovariotomy, two years after the opening of this college. His younger and in his day even more influential contemporary, Benjamin W. Dudley, had already entered upon practice, which he was soon to interrupt, in order to secure the advantages of medical study in Europe, in this following McDowell's excellent example. In the year this college was opened there began to practice in Cincinnati Daniel Drake, the physician most typical of peculiarly American conditions, a genuine product of the soil, unlike McDowell and Dudley not trained in foreign schools, a real builder and great citizen, who spent forty years in accumulating the material for his monumental work on the "Diseases of the interior valley of North America."

The membership of the first and immediately succeeding faculties of the College of Physicians and Surgeons affords abundant evidence that New York had its full share of able physicians and surgeons, distinguished in their day and deserving our grateful remembrance. These were Nicholas Romayne, the first president and the one most active in the establishment of the college, an energetic, ambitious and powerful personality; Samuel Latham Mitchill, the most celebrated member of the faculty, the scientific oracle of the day, credited with universal learning, Senator of the United States, an active supporter of Robert Fulton, in whose first steamboat, the Clermont, he was a passenger on its first journey up the Hudson, the centennial anniversary of which coincides with that of this college; Samuel Bard, the second president of the college, now engaged in raising sheep and studying their diseases, who had for several years retired from practice, and has already been mentioned; his pupil, friend, partner, and successor, David Hosack, who became the dominant spirit in the college, already the leading physician of the city, and, like his pupil, John W. Francis, who was a member of the first graduating class and soon afterward of the faculty, combining social, literary, and scientific interests with those of his profession; Wright Post, who continued worthily the line of important New York surgeons begun by John Jones and soon to be adorned by the name of his greater colleague, Valentine Mott, the most celebrated operator of

his day in this country, who became a member of the faculty in 1813, as did Post, when the medical faculty of Columbia College was absorbed by the College of Physicians and Surgeons; Edward Miller, sharing with Smith and Mitchill the fatherhood of medical journalism in this country, the first clinical teacher connected with the college, the scholarly author of medical papers of permanent value; William James Macneven, a leader with Emmet of the United Irishmen, the first of our medical refugees for political cause, a man of rare accomplishments, distinguished in his profession, establishing in this college in 1811 the first chemical laboratory in New York; John Augustine Smith, a Virginian, member of the first faculty, later president of William and Mary College, again professor and for twelve years president of the College of Physicians and Surgeons; James S. Stringham, an efficient early promoter of science in the United States, a pioneer teacher of medical jurisprudence in this country, a subject cultivated with distinguished success by Theodore Romeyn Beck, a member of the first graduating class, assisted by his younger brother, the learned John B. Beck, also a graduate, and for many years professor of materia medica and medical jurisprudence in the college; Archibald Bruce, a name familiar to mineralogists, giving to the College of Physicians and Surgeons the singular distinction of establishing the first chair of mineralogy in this country. There was also established in 1814, a professorship of natural philosophy held by Benjamin DeWitt, who had been a member of the faculty from the beginning. It is somewhat interesting to note the varied nationalities represented in the immediate or near ancestry of these members of the first faculties, viz.: English, Scotch, Irish, Dutch, French Huguenot, German, and Swiss.

A characteristic feature of American medicine in the period which we are now considering is the position of extraordinary preeminence occupied by the leaders during their day and generation. We cannot read today without a smile, in the biographical dictionaries of Thacher, Williams, and Gross, the glowing eulogies of the resplendent virtues and immortal fame of men whose names are overlooked in the histories of universal medicine or receive perhaps a line or two. The height to which these men attained is to be measured by the generally low level of attainment of their professional brethren rather than by their own actual contributions. Our national medical heroes of this period played upon a small stage a part which then seemed large. A few, chiefly surgeons, as McDowell, Nathan Smith, Warren, and Mott, contributed not a little to improvement of the art and many were well educated men of force and ability who did much to elevate professional standards in America. There will never exist again, in this country, so great a disparity of attainment in the members of our profession,

and the few can never rise again so high above the general level of their colleagues.

Biographical sketches and the many addresses of Hosack and of Francis afford us abundant material for learning what manner of men were the early occupants of the professional chairs in this college and what social and professional conditions surrounded them. Especially rich in information of this character is Dr. Francis's delightful book "Old New York."

Bard, Hosack, and Francis, each the foremost physician of his day in this city, belong to the medical lineage of John Radcliffe and Richard Mead and had the gold-headed cane crossed the Atlantic, it would have descended in succession to them. Francis was the last representative in this city of this type of physician—inheritors and conservators of old traditions, representatives of the best practice of the times, whose large success and dominant influence rest upon good sense and strongly marked personal characteristics rather than great learning, remembered long by anecdote and tradition, prominent figures not in professional circles alone, but also in the public, the social and the literary life of the city, dispensers of a generous hospitality in homes frequented by the wits and notables of the day.

Bard, Hosack, and Francis, while under the influence of the prevailing medical theories of Boerhaave, Van Swieten, Cullen, Brown and Rush, were each imbued with a saving measure of the inductive method. Hosack advocated vigorously the establishment of municipal hospitals for contagious diseases, national quarantine regulations, and a proper system of city drainage. His "Observations on febrile contagion and on the means of improving the medical police of the city of New York" should perpetuate his memory in this city. Although the author of "A system of practical nosology," as dreary as similar works, he said that the principles of medical practice must be gained through "accurate observation, judicious experiment, and cautious induction from the facts which they present," and we can say nothing more and nothing better today. In a like spirit Francis says: "It may be written as an axiom, you might as well create a practical navigator by residence in a sylvan retreat, as furnish a physician without hospital experience."

The character of the early medical schools of this country was determined largely by the influences and traditions of the school at Edinburgh, where the founders and first teachers of our schools received the most valuable part of their professional training under such teachers as Cullen, the Monros, Whytt, Black, Hope, the Gregorys and the Hamiltons. When the College of Physicians and Surgeons was founded, medical teaching was still much better organized and conducted in Edinburgh than in London, but the immediate successors of Cullen, the second Monro and Black, were

less important and able teachers than their predecessors, and American students of medicine at this period in Great Britain received the greatest stimulus from the extramural teaching of John Bell and John Barclay in Edinburgh and from study under Abernethy, Astley Cooper and others in London.

It was especially during the first two decades of the nineteenth century that the influences of English, as distinguished from Scottish, medicine were brought to this country, although these influences were not lacking at an earlier period, especially upon surgery. Thus Thomas Cadwallader of Philadelphia had been a pupil of Cheselden, John Jones of Percival Pott, and the American pupils of the Hunters were fairly numerous, including among others Jones, Morgan, Shippen, Bard, Bayley, and Physick. Although not a teacher, there was no British physician who took so active and friendly an interest in medical conditions in this country and in American students visiting Great Britain in the latter half of the eighteenth century as did the great London physician, John Fothergill. He had many correspondents in America, was the adviser of Morgan and of Bard in planning the first medical schools in Philadelphia and in New York, was a generous benefactor of the Pennsylvania Hospital, was one of the incorporators of the New York Hospital, the charter of which was granted in 1771, and he assisted in raising money for it. His name we should hold in grateful remembrance, as well as that of his friend and successor, another quaker physician of London, John C. Lettsom, who continued after Fothergill's death to manifest a similar interest.

Of the many teachers of medicine in London in the early part of the nineteenth century the two who stand out most conspicuously above their contemporaries as an attraction to students and exerting a far reaching influence are John Abernethy and Astley Cooper, both pupils of John Hunter, Abernethy being the especial custodian of Hunter's physiological views, a vigorous and admirable teacher with remarkable powers of exposition, and Cooper, an interesting practical lecturer, meddling little with theories, and occupying a position before the public such as probably no surgeon before or since has held. These great teachers inspired, as few have done, their pupils with enthusiasm and when we recall that among their American pupils were such men as David Hosack, James Jackson, John Collins Warren, Nathaniel Chapman, John Syng Dorsey, Valentine Mott, William Gibson, Benjamin W. Dudley, John W. Francis, Alexander H. Stevens, Edward Delafield, John Wagner, John Kearny Rodgers, we can realize the great influence which they must have exerted upon the generation of American physicians and surgeons of the first quarter of the last century, an influence which has hitherto hardly received the attention from

medical historians which it merits and which was comparable, although quite different in kind, to that brought to this country at a later date by the pupils of Louis.

In general the conditions of medical teaching in London at this period were far from satisfactory. There were no completely and properly organized medical schools. There were many private medical schools of which the best continued to be the Great Windmill Street School, founded by William Hunter, where William Hewson, Matthew Baillie, and William Cruikshank had taught the latter part of the eighteenth century, and where in the first and second decades of the succeeding century the leading teachers were James Wilson, Benjamin Brodie, Charles Bell, and John Shaw. The independent schools of John Sheldon and of Andrew Marshall in the latter part of the eighteenth century had also been much frequented by American students, and at a later period we hear of many other private schools, as the Webb Street School, Aldersgate Street School, Little Dean Street School, Carpue's, Brookes's, Haighton's, Hooper's, Taunton's, Dermott's, and others. It was not uncommon for a physician or a group of physicians to advertise in the newspapers courses of lectures, and in some instances the purpose seems to have been mainly the advertisement rather than the expectation of securing students.

Lectures to students were given at several of the hospitals, the best at the United Borough Hospitals (St. Thomas's and Guy's) by Cooper, the Clines and Babington; at St. Bartholomew's by Abernethy and his demonstrator William Lawrence, James Earle, the son-in-law of Percival Pott and at this time the leading surgeon to the hosiptal, and Richard Powell; at St. George's by Sir Everard Home and his demonstrator and assistant Benjamin Brodie, and George Pearson, a very successful and popular teacher of medicine and chemistry; at the London Hospital, by Sir William Blizard and John Cooke; at Westminster Hospital by Sir Anthony Carlisle, and at Middlesex Hospital by Charles Bell, already engaged in those investigations of the nervous system which have immortalized his name. Matthew Baillie was the leader of the medical profession in London at this period and his influence was strongly felt, although he had ceased teaching before the century opened. Notwithstanding their able teachers it was not until the fourth decade of the nineteenth century that the hospital medical schools, gained the ascendancy over the private schools, some of which continued to exist until long after the middle of the century.

The subjects most thoroughly cultivated and taught in London were anatomy, surgery, and midwifery, and it is upon these subjects more than upon internal medicine that the impress of English influences has been most strongly marked in this country. The teaching of anatomy and surgery

was usually combined. The list of important teachers, beginning in the first quarter of the eighteenth century with Cheselden and John Douglas, is a long one and includes Samuel Sharp, Edward Nourse, Percival Pott, William and John Hunter, Henry Cline, Sir William Blizard, Sir James Earle, John Abernethy, Sir Everard Home, Sir Astley Cooper, Sir Anthony Carlisle, and Sir Charles Bell, and of a generation beginning their activity in the first and second decades of the nineteenth century Sir Benjamin Brodie, Sir William Lawrence, Benjamin Travers, and Joseph Henry Green. More especially known as teachers of anatomy in London from the middle of the eighteenth century on were William Hewson, John Sheldon, Andrew Marshall, William Cruikshank, Matthew Baillie, James Wilson, Joshua Brookes, and Joseph Carpue. The important names as teachers of midwifery beginning with James Douglas early in the eighteenth century were William Hunter, William Smellie, Thomas Denman, William Osborne, John and Sir Charles Clarke, Samuel Merriman, and Robert Gooch. The Dublin School of Midwifery founded by Sir Fielding Ould and John Fleury soon after the middle of the eighteenth century reached a high point of efficiency and prosperity under Joseph Clark at the period which we are considering.

George Fordyce and William Saunders, both Scotsmen and pupils of Cullen, had introduced in London in the latter part of the eighteenth century the Cullenian doctrines and system of teaching medicine. The great reform in clinical teaching initiated by Graves and Stokes in Dublin and by Richard Bright, Thomas Addison, Peter Mere Latham, and Archibald Billing in London in the third decade of the nineteenth century came at a time when the influence of French medicine began to be more strongly felt in this country, and it is more especially to the latter that the corresponding improvement in America is to be attributed.

In two special directions there were excellent opportunities for training in London at this period, namely in cutaneous diseases under Robert Willan and Thomas Bateman, and in ophthalmology and otology under John Cunningham Saunders, who was active in founding the institution now known as Moorfields Ophthalmic Hospital, and at a little later period under Travers, Lawrence, and Guthrie. In the second decade of the nineteenth century Edward Delafield, for many years president of this college, returned after studying in London and with J. Kearny Rodgers established in 1820 the New York Eye and Ear Infirmary, with which he was connected for fifty years, and introduced there and in college the teaching of ophthalmology.

This period of English medicine, to which we must attribute an especial influence upon medicine in this country, was by no means sterile, although overshadowed by the more vital brilliant contemporaneous school in Paris.

The English surgeons were at least the equals of their French contemporaries. The influence of Percival Pott and of John Hunter upon their pupils and successors was profound and most stimulating. Matthew Baillie had created an interest in morbid anatomy which led to many valuable contributions and prepared the way for Bright, Addison, and Hodgkin. The admirable and distinctive type of English physician which has been represented by such men as Sydenham, Huxham, Fothergill, and Heberden was perpetuated by Baillie, Baker, Pitcairn, Saunders, Latham, Powell, and others. Charles Bell was laying the foundations of neurophysiology. There was great interest in physiological experimentation and in experimental science in general. The great natural philosophers Thomas Young and Wollaston were actively identified with the medical profession and the genius of Sir Humphrey Davy had been fostered under medical surroundings. American students in London at this time often speak with enthusiasm of the lectures of Davy at the Royal Institution founded by their countryman, Count Rumford. The study of the natural sciences, particularly of botany and of chemistry, was very generally combined with that of medicine, and many of our American students of medicine returned well grounded in these sciences as they then existed and continued to cultivate them. Reference has already been made to the position which these sciences occupied in the curriculum of our medical schools, which were at this period their chief home in this country.

While it is evident that we can attribute much that is valuable to the influence of English upon American medicine at the period when the College of Physicians and Surgeons was founded, familiarity with the system of medical teaching then prevalent in London did not exert an influence upon the development of medical education in this country so fortunate as that derived from Leyden and from Edinburgh had done upon our first medical schools. The idea of establishing private medical schools divorced from any connection with a college of liberal arts or a university and free from any responsible control was transplanted to this country from London and was developed to an extreme which became peculiarly American. The London schools never dreamed of conferring the doctor's degree or of granting the license to practise. They encountered opposition even in having their courses recognized by the examining and licensing bodies, and their defects were largely compensated by the practical training secured by the apprenticeship system and by hospital pupillage and dressership.

Undoubtedly special conditions pertaining to the rapid pioneer development of the country contributed to the establishment in the second and later decades of the last century of many private medical schools which brought our system of medical education to such a low standard of efficiency

and introduced evils from which we are not yet wholly free. An interesting and distinctively American type of physician sprang from these peculiar conditions, namely the peripatetic professor who, travelling from school to school, often acquired great fame as a lecturer. Out of a long list John Delamater (1787-1867) may be selected as probably unsurpassed as a college lecturer of this type. He lectured at Pittsfield, Fairfield, Willoughby, Geneva, Cleveland, Bowdoin, and Dartmouth, and left manuscript notes of over seventy different courses on almost every branch of medicine.

At the time of the organization of the College of Physicians and Surgeons the great awakening which marked the dawn of a new era was already under way in France, but the new movement was slow in spreading and it was not until the fourth decade of the last century that it reached America, where it proved as fructifying a power for good as it had been elsewhere. The movement ultimately led to the establishment of the science of medicine upon a broad, biological basis. It was ushered in toward the close of the eighteenth century by Lavoisier's discovery of the true nature of respiration and of the sources of animal heat. The chief instruments of advancement in the beginning were general and pathological anatomy in the hands of Bichat and his successors and the introduction of the methods of percussion and auscultation of the chest by Corvisart and by Laennec, the "Anatomie générale" appearing in 1801, Corvisart's translation of Auenbrugger's "Inventum novum" in 1808 and Laennec's "De l'auscultation médiate" in 1819. The immediate result for medicine was the substitution, wherever possible, of the anatomical study and classification of disease for the old, purely symptomatic classification.

The power of the new methods and conceptions was speedily demonstrated by the discoveries of Bayle, Corvisart, Laennec, Bouillaud, Cruveilhier, Piorry, Louis, Andral, and others relating to tuberculosis and diseases of the heart and lungs and somewhat later by the work of Bright and Rayer on diseases of the kidneys, of Bretonneau on diphtheria, and of Louis and his pupils on typhoid fever. The dangers of incomplete and too exclusive anatomical study of disease and of one-sided application of anatomical conceptions to clinical medicine were at the same time illustrated by the pernicious doctrines of Broussais. In the third and fourth decades of the century the significance, which today is so much and so properly emphasized, of physiological and chemical methods in the study of disease began to be apparent through the work of Magendie and of Liebig.

This most glorious period of French medicine culminated in the work of Louis, with whose name is associated especially the so-called analytical or statistical study of disease on both the clinical and the anatomical sides. Through the writings of Laennec and of Louis, and above all by that remark-

able group of able and enthusiastic young American physicians who were students of Louis between 1830 and 1840, as the younger Jackson, Shattuck, Holmes, Gerhard, Stillé, Power, Swett, and Clark, the new medicine was introduced and soon spread in America. Although Swett was the pioneer in this city, Alonzo Clark was its apostle to this college, with which he became connected in 1841. His coming and that of Willard Parker, the year before, who began systematic clinical teaching, marked an epoch in the history of the college. The ablest and most representative American exponents of the fertility of Louis's analytical method of clinical study were Elisha Bartlett and Austin Flint. More original was the teacher of Swett and of Flint, Jacob Bigelow, who, although imbued with the new ideas, was neither the product nor the adherent of any special school, was a profound and fertile medical thinker of real genius, and with his colleague, James Jackson, the elder, shed great luster upon the Harvard Medical School.

By this time German medicine had broken the trammels of the philosophy of nature which bound it in the early part of the century. In Vienna Rokitansky, Skoda, and Oppolzer had advanced far along the path first opened in France; Schoenlein was developing the modern German clinic; the golden age of physiology marked by the work of Claude Bernard in France and of Johannes Müller and his pupils, Du Bois Reymond, Brücke, Ludwig, and others in Germany had begun, and soon after the middle of the century the cell doctrine had been made by Virchow the immovable corner-stone of pathology. Laboratories, that great contribution of Germany to scientific teaching and investigation, were established and rapidly developed during the second and third quarters of the nineteenth century, first for physiology, then for chemistry, pathology, pharmacology, and hygiene, anatomy being the fortunate possessor of laboratories centuries before. Mainly through her laboratories Germany secured about the middle of the century that leadership in medical science which soon turned to her universities the stream of foreign students.

The powerful influences of German medical science upon American medicine were not brought to this country by so compact a group of physicians or within so sharply defined a period and were not so immediately operative and are, therefore, not so readily traceable as the impulses from France which I have mentioned. They have, however, been the pervasive and dominant foreign influences of the last four decades.

American medicine owes a large debt to German physicians who have settled in this country, to such men as Engelmann of St. Louis and Detmold, who came in the thirties, especially to the men of 1848, brilliantly represented by our own Jacobi and Krackowitzer, and to many of a later period. Soon after the middle of the century their influence began to be distinctly

apparent. During and after the sixties the stream of young American physicians returning from their graduate studies in German and Austrian universities introduced in constantly increasing measure those methods and ideals of German medical science which have so profoundly and beneficially influenced American medicine. To this direction of development an especially strong impetus was given in the late seventies and eighties by the rise of modern bacteriology following the discoveries of Pasteur and of Koch.

To Francis Delafield and later to T. Mitchell Prudden this college owes a debt of gratitude for the introduction of the new methods in teaching and for the establishment of a pathological laboratory under difficult material conditions. Dr. Prudden's dark tunnel of a laboratory replacing an ice-cream saloon in the old Twenty-third Street building marked the beginning of that development of laboratories which has become so important a feature of the college in its new home and from which so much valuable work has issued. It is gratifying to record the moral and material support given to this movement by the alumni association of the college.

In directing attention, as I have attempted to do, to the successive periods in which Scotch, English, French, and German influences upon American medicine were especially noticeable, I would not have it understood that foreign influences at any time supplanted native forces. The names of many of those whom I have had occasion to mention testify that such influences enriched a soil already occupied with germinating seeds and did not breed mere slavish disciples. Many of our ablest and best physicians and surgeons, such as John Warren, Godman, Jacob Bigelow, Dewees, Drake, Torrey, the Becks, to mention only a few names of the early part of the last century, received their entire training in this country. Besides the impulses received from contemporary European medicine there have at all times been manifold and diverse circumstances which have influenced for good or for ill the development of medicine in this country, such as the material, political and social conditions prevailing at different times and in different places, the national habits, temper and ideals, the rewards of professional successes, the qualities of those attracted to the profession and many other conditions which cannot be considered on this occasion.

We have our own educational and professional problems, peculiar to the special conditions of our country, and they cannot be satisfactorily solved by the transplantation of foreign systems, although we may receive guidance from the experience of older countries. Medicine has become cosmopolitan and we can no longer speak with propriety of exclusively national schools of medical thought and teaching. America is destined to make her own contributions to the world problems of education, science and art, and to repay the debt which she owes to other countries.

The elevation of educational standards in our better medical schools during the last quarter of a century has been most gratifying, and in this movement the College of Physicians and Surgeons has had a conspicuous share. Laboratory teaching has advanced from the weakest to the strongest position in the curriculum. The question may even be raised whether in some instances too much time may not be occupied by the instruction of students in laboratories, although I should be reluctant to concede this. I believe that at the present moment improvement in opportunities and methods of clinical training is a more urgent problem that the teaching of the so-called laboratory subjects. Something more than the amphitheater clinic or the ward class, useful as these are, is needed to furnish training in practical medicine and surgery analogous to that supplied by practical work in the laboratory and to make capable practitioners. To secure this, dispensaries and the public wards of hospitals must open their doors more freely to advanced under-graduate students of medicine, and I have recently in an address at the opening of the new Jefferson Medical College Hospital endeavored to show that this can be done with advantage not only to the teachers and students, but also to the patients and the general efficiency and usefulness of the hospital.

I can wish no greater good fortune to the College of Physicians and Surgeons or indeed greater benefaction to the cause of medical education in this country than that it should come into possession of a general hospital of its own. Next to this is the establishment of such relations with public hospitals in this city as will render possible for its students such clinical training as I have indicated, and I understand that steps have already been taken to secure this result. The medical schools of New York, through failure to avail themselves fully of the immense clinical opportunities of the public hospitals in this city, do not secure the full advantages of location which rightfully belong to them.

There are at least two important fields of study and practical work which are not yet adequately represented in our medical schools. We greatly need psychopathic hospitals or wards attached to general hospitals, and also the establishment of well equipped laboratories where students and physicians can be trained in public hygiene. As regards the latter we are at present within a vicious circle. On one hand, there is little appreciation on the part of the public and of municipal and state authorities, indeed, I think, also of the profession, of the necessity of special training for those appointed as health officers, and, therefore, in lack of careers there is little encouragement to secure the training, and, on the other hand, skilled hygienists are so few that the value of their expert knowledge is not made sufficiently evident to the public. It does not seem possible that such conditions can long continue,

and attempts to improve them have already begun. I do not know where more favorable conditions can be found for the establishment of a department of public hygiene to supply the training needed by those who wish to engage in public health work than in this city.

Upon anniversaries like the present attention is usually turned in the first instance to the past. The survey of honorable records and achievements supplied by the history of the College of Physicians and Surgeons is full of hope and encouragement for all of us interested in its welfare. As it enters in full vigor upon the second century of its existence, our college, fortunate in its vital union with Columbia University, looks forward with confidence to a future of expanding resources and ever increasing usefulness and power for good in the education of students, in the advancement of knowledge, and in the prevention and relief of human suffering and disease.

THE UNITY OF THE MEDICAL SCIENCES[1]

The dedication of the new buildings of the Harvard Medical School is an occasion for rejoicing not to Harvard University alone but to all in this country and elsewhere interested in the progress of medical education and of medical science, and in behalf of all such I beg to offer to this university hearty congratulations upon this magnificent addition to its resources for medical teaching and study. Medicine everywhere and especially in America has reason to be profoundly grateful to the generous and public-spirited donors who have made possible the construction of this group of buildings, unsurpassed in the imposing beauty and the harmony of their architectural design and in their ample, internal arrangements. This design is adapted from the Greek, and it is peculiarly fitting that the medical sciences should be housed in a style which suggests the spirit of ancient Greece, where first flowed the springs of medical science and art—living springs even to this day. In the singular harmony of the architecture of the group of buildings devoted to the various medical sciences are typified the unity of purpose of these sciences and their combination into the one great science of medicine. What I shall have to say on this occasion is suggested in part by this thought of the "Unity of the Medical Sciences."

The good fortune of the Harvard Medical School in coming into possession of the splendid laboratories now formally dedicated is well merited by the leading position which this institution has held in this country since its foundation, by its union with Harvard University, and by the assurance that the greatly enlarged opportunities will here be used to the highest advantage. Since the appointment in 1782 of its first professors, John Warren and Benjamin Waterhouse, of enduring fame, this school has had a long line of honored names upon its roll of teachers, lustrous not only for such single stars as Channing and Ware and Holmes and Ellis and Cheever, but especially for its clustered stars, the Warrens, the Jacksons, the Bigelows, the Shattucks, the Wymans, the Bowditches, the Minots; and it will not be deemed invidious on this occasion to mention of the latter group the names of two members of the present distinguished faculty to whose services this school is so largely indebted for securing the funds for the

[1] An address delivered at the Dedication of the New Buildings of the Harvard Medical School, Harvard University, Boston, September 26, 1906.

Boston M. & S. J., 1906, CLV, 367-372.

new buildings, Professor Henry P. Bowditch, the eminent leader of American physiologists, and Professor John Collins Warren, who, as surgeon, writer and teacher, has so worthily maintained and enhanced the ancestral fame.

The Harvard Medical School has been a pioneer in this country in many improvements of medical education; it has stood successfully in an historic city and commonwealth for high standards of professional attainment and honor, and for just recognition of the dignity and usefulness of the profession; it has made valuable contributions to the advancement of medical knowledge and practice, and above all there issued from this school and the Massachusetts General Hospital through John Collins Warren, the elder, and William T. G. Morton medicine's supreme gift to suffering humanity of surgical anaesthesia.

This school, however, has no possession so valuable or which gives such assurance of its stability and growth for untold generations to come and of the worthy bestowal of the great gifts which were dedicated yesterday as its union with Harvard University, and it is befitting that the significance of this university relationship should be emphasized by including among the dedicatory ceremonies this academic function in the halls of this great university.

The severance of the historical union of medical school and university, leading to the establishment of a multitude of independent medical schools without responsible control, and usurping the right to confer the doctor's degree and the license to practise, is accountable in large measure for the low position to which medical education in this country sank during the larger part of the last century, and from which it has now risen in our better schools to a height which we can contemplate with increasing satisfaction. Nor would it be difficult to show, if this were the suitable occasion, that our universities on their side have suffered from the loss of a member which has brought renown to many foreign universities and that many of the embarrassing anomalies of our collegiate system of education are due to lack of personal contact on the part of colleges and universities with the needs of professional, especially medical, training. There is, of course, no saving grace in a merely nominal connection of medical school and university; the union to be of mutual benefit must be a real and vital one; ideals of the university must inspire the whole life and activities of the medical department.

To have recognized fully, from the beginning of his administration, the importance of this vitalizing union of the medical school with the university, to have striven patiently with full grasp of the problems and with intelligent sympathy with the needs of medicine for the uplifting of the

standards of medical education, and, with the aid of his medical colleagues, to have planted these standards where they now are in the Harvard Medical School, is not the least of the many enduring services which President Eliot has rendered to American education, and, in behalf of our profession, I wish to make to you, sir, on this occasion, grateful acknowledgment of this great and beneficent work.

The opening of the new laboratories of the Harvard Medical School marks the culmination, up to the present time, of an educational and scientific movement which has been the most distinctive characteristic of the development of medicine during the past fifty years, and which has transformed the face of modern medicine. To have some idea of the extent and the direction of this development, consider how inconceivable would have been the mere existence of such laboratories a century ago, and how impossible it would have been for even a Bichat or a Laënnec to have put them to any use or to have imagined their use. The only scientific laboratory which existed at that time was the anatomical, and this had been in existence for at least two hundred and fifty years, although not in a form which meets our present ideas of such a laboratory.

The modern scientific laboratory was born in Germany in 1824 when Purkinje established the first physiological laboratory, thus antedating by one year the foundation of Liebig's chemical laboratory, which had a much greater influence upon the subsequent development of laboratories. As might naturally be expected, anatomical and physiological laboratories had attained a considerable development before the first pathological laboratory was founded in Berlin by Virchow. The opening and activities of this laboratory, which has recently celebrated its fiftieth anniversary, mark an era in the progress of medicine. With the exception of the modest beginning of a pharmacological laboratory by Buchheim about 1850, all of the other medical laboratories—those of physiological chemistry, of hygiene, of bacteriology, of clinical medicine—originated at a much later date.

This remarkable growth of laboratories for the cultivation of the various medical sciences has been at once the cause and the result of the rapid progress of medicine in recent years. By teaching and exemplifying the only fruitful method of advancing natural knowledge, laboratories have overthrown the dominance of authority and dogma and speculation and have turned medicine irrevocably into the paths of science, establishing the medical sciences as important departments of biology; by demonstrating that the only abiding, living knowledge, powerful for right action, comes from intimate, personal contact with the objects of study, they have revolutionized the methods of medical teaching; by discovery they have widened

the boundaries of old domains and opened to exploration entirely new fields of knowledge, by the application of which man's power over disease has been greatly increased.

Medicine, as a science, is occupied with the systematic study of the structures and functions of the human and animal body in health, of their changes by disease and injury, and of the agencies by which such morbid changes may be prevented, alleviated or removed. Its ultimate aim, which indicates also its method, is that of all science, the deduction of general concepts and laws from the comparison of the relationships and sequences of ascertained facts, and the application of these laws to the promotion of human welfare. This goal, today far from realization, is most nearly approached where the principles of physics and of chemistry can be applied, but there remains a large biological field awaiting reclamation for the application of these principles. The subject-matter of medical study, as thus indicated, is of supreme import to mankind, but complex and difficult far beyond that of any other natural or physical science.

The places where such study may be most advantageously carried on are laboratories and hospitals supplied with the material for study, with the necessary instruments, appliances and books, and with trained workers. By growth of medical knowledge the field to be covered has become so vast as to require much subdivision of labor, nor is it to be supposed that the end of this subdivision has been approximately reached.

From human anatomy, the mother of medical as well as of many other natural sciences, there branched off in the eighteenth century physiology, and, still later, pathological anatomy. As if to replace these losses anatomy gave birth to comparative anatomy, embryology and microscopic anatomy as more or less separate branches. During the past century physiological chemistry and pharmacology have separated from physiology, and comparative pathology and experimental pathological physiology are asserting their independence from pathological anatomy. Hygiene and bacteriology are of recent and more independent growth. The latter, lusty stripling, with the rise of medical zoology, especially protozoology, is seeking a more comprehensive and appropriate designation. The latest and perhaps the most significant development is the clinical laboratory in its various forms.

Specialization in scientific work should not be decried; it is demanded by the necessities of the case and has been the great instrument of progress, but the further division of labor is carried, the more necessary does it become to emphasize essential unity of purpose and to secure coordination and cordial cooperation of allied sciences. Especially urgent is full recognition of the unity and cooperation of the clinic and the laboratory.

During the last two decades we have witnessed in this country the extraordinary rise of practical laboratory instruction from the weakest to the strongest and best organized part of the medical curriculum of our better schools. Our laboratory courses are, I believe, in several instances, more elaborate and occupy more time than corresponding ones in most foreign universities.

It is, however, as was emphasized by Dr. Dwight and Dr. Shattuck in their remarks yesterday, an error to suppose that from the point of view of science any fundamental distinction exists between the clinical and the so-called laboratory subjects other than that based upon differences in the subject-matter of study. The problems of the living patient are just as capable of study by scientific methods and in the scientific spirit, and they pertain to independent branches of medical science, just as truly as those of anatomy, physiology or the other so-called laboratory subjects. All of the medical sciences are interdependent, but each has its own problems and methods, and each is most fruitfully cultivated for its own sake by those specially trained for the work.

There is a highly significant and hopeful scientific movement in internal medicine and surgery today characterized by the establishment of laboratories for clinical research, by the application of refined physical, chemical and biological methods to the problems of diagnosis and therapy, and by the scientific investigation along broad lines of the special problems furnished by the living patient. The most urgent need in medical education at the present time in this country I believe to be the organization of our clinics both for teaching and for research in the spirit of this modern movement and with provision for as intimate prolonged, personal contact of the student with the subject of study as he finds in the laboratory.

In addition to undergraduate instruction our laboratories at present furnish better opportunities for the prolonged, advanced training of those intending to make their careers in anatomy, physiology, pathology and other sciences, than are afforded by most of our hospitals to those who aim at the higher careers in medicine and surgery. A further clinical disadvantage is that while the former class after good scientific work may reasonably look forward to desirable positions as teachers and directors of laboratories, the latter, however high their attainments, in consequence of the separation of the medical school from any control over the appointments to the hospital staff, cannot anticipate with any degree of assurance similar promotion in their chosen lines of work, and consequently the medical faculty has not so wide a field of choice in filling the clinical chairs as in filling those of the auxiliary sciences.

The removal of these deficiencies on the clinical side of medical education in America requires some reorganization of its staff on the part of the hospital and the control by the medical school of its hospital, or, at least, its voice in appointments to the hospital staff. So far as our resources permit, we have, I think, accomplished this reform at The Johns Hopkins Medical School and Hospital.

The welfare of the patient is the first obligation of the trustees of hospitals and of physicians in attendance, but nothing is more certain than that cordial cooperation between medical school and hospital best subserves the promotion of this welfare. Fortunate the hospital and fortunate the patients brought into such relations with the Harvard Medical School.

As is strikingly illustrated by the new buildings of this school, the educational machinery of medicine today is vastly complicated and costly compared with the simplicity of the days when a lecture room, a dissecting room, a simple chemical laboratory, and a clinical amphitheatre were all that was needed. The purpose of medical education, however, remains today what it has always been and will continue to be—the training of the student for the future practice of his profession, and to this end in an harmonious scheme of education the various medical sciences all work together. Right action requires abundant knowledge, nowhere more so than in medical practice, and the all-sufficient justification for the position held by the various sciences in the preliminary and the professional education of the physician is that they furnish knowledge and discipline of mind needed in the preparation for his future work. The social position of the medical man and his influence in the community depend to a considerable extent upon his preliminary education and general culture. For this reason, as well as for his intellectual pleasure in his profession and as a sound foundation for his future studies, the student should enter the medical school with a liberal education, which should include training in the sciences fundamental to medicine.

The unity of the various medical sciences is manifested not only in their historical development and in their cooperation in the scheme of medical education, but especially in their contributions to the upbuilding and progress of medicine as a whole.

There is no branch of medicine or even of physical science which has not played an important part in the evolution of our present medical knowledge and beliefs. The great lesson taught by the history of this development of medicine through the centuries has been the unconditional reverence for facts revealed by observation, experiment and just inference, as contrasted with the sterility of mere speculation and reliance upon transmitted authority. The great epochs of this history have been characterized by some great dis-

covery, by the introduction of some new method, or by the appearance of some man of genius to push investigation and scientific inference to limits not attainable by ordinary minds. The history of medicine has a greater unity and continuity, and extends over a longer period of time, than that of any other science.

The first clear note, which has rung down the ages, was sounded by Hippocrates when he taught the value of the inductive method by simple, objective study of the symptoms of disease, and the cry "Back to Hippocrates!" has more than once recalled medicine from dogmas and systems into sane and rational paths. Medicine, however, was handed on from the Greeks and Romans in bondage to a system of doctrine, constructed by Galen, so completely satisfying to the mediaeval mind that this system remained practically untouched for over a thousand years.

With the liberation of intellect through the renaissance came the great emancipators, in the sixteenth century Vesalius, and in the seventeenth, Harvey, the former placing human anatomy upon a firm foundation and bringing medicine into touch with the most solid basis of fact in its domain, the latter bringing to light in the demonstration of the circulation of the blood the central fact of physiology and applying for the first time in a large and fruitful way to medicine the most powerful lever of scientific advance, the method of experiment.

In the century of Galileo, Harvey and Newton instruments of precision, as the chronometer, the thermometer, the balance, the microscope, were first applied to the investigation of medical problems, and physics began to render those services to medicine which, continued from Galileo to Röntgen, have been of simply incalculable value. The debt of medicine to chemistry began even with the rise of alchemy, received an immense increment from the researches of Lavoisier, the founder of modern chemistry, concerning the function of respiration and the sources of animal heat, and has grown unceasingly and to enormous proportions up to these days of physical chemistry, which has found such important applications in physiology and pathology.

How disastrous may be to medicine the loss of this sense of unity in all its branches has been very clearly and admirably shown by Professor Allbutt in depicting the effects which, for centuries, followed the casting off from medicine of surgery as a subject unworthy the attention of the medical faculty. Thereby internal medicine lost touch with reality and the inductive method, and remained sterile and fantastic until the days of Harvey, Sydenham and Boerhaave. The services of surgery to medicine as a whole, so brilliantly exemplified in the experimental work of John Hunter in the eighteenth century, have become a distinguishing feature of the medicine of the present day.

The great awakening of clinical medicine came in the early part of the nineteenth century from the introduction of the new methods of physical diagnosis by Laënnec and from pathological anatomy. The subsequent development of scientific and practical medicine has far exceeded that of all the preceding centuries. It has kept pace with the progress during the same wonderful century of all the sciences of nature and has contributed even more to the promotion of human happiness.

In anatomy with embryology and histology, in physiology, pathology, physiological chemistry, pharmacology, hygiene, bacteriology—sciences which are ancillary to medicine and at the same time important branches of biological science—there have been marvelous activity and expansion. For physiology and the understanding of diseases, the establishment of the cell doctrine by the aid of botany, embryology, and pathology has been the greatest achievement. By the combined aid of physiology, physiological chemistry, experimental pathology, improved methods of diagnosis and clinical study, medicine has gained new and higher points of view in passing from too exclusive emphasis upon the final stages of disease revealed by morbid anatomy to clearer conceptions of the beginning and progress of morbid processes as indicated by disturbances of function, and above all has penetrated to the knowledge of the causation of an important class of diseases, the infectious. As a result of this rapid growth of knowledge in many directions has come a great increase of the physician's power to do good by the relief of suffering and the prevention and cure of disease.

In this connection I wish especially to emphasize the mutual helpfulness of the various medical sciences in the development of medical knowledge and practice. Attention is generally so concentrated upon the final achievement that there is danger of losing sight of the manifold sources which have contributed to the result. Let my medical hearers consider, for example, the indispensable share of embryology, of anatomy, gross and microscopic, of physiology, of pathological anatomy, of clinical study in the evolution of our knowledge of the latest contribution to diseases of the circulatory system—that disturbance of the cardiac rhythm called "heart-block." Similar illustrations of the unity of the medical sciences and of the cooperation of the laboratory and the clinic might be multiplied indefinitely from all classes of disease.

The same phenomenon is exhibited in medicine as in all science, that the search for knowledge with exclusive reference to its practical application is generally unrewarded. The student of nature must find his satisfaction in search for the truth, and in the consciousnes that he has contributed something to the fund of knowledge on which reposes man's dominion over reluctant matter and inexorable forces.

How readily better action attends upon increased knowledge is shown by the part which the art of medicine is playing and is destined to play even more prominently in the world's progress. The value of this work of modern medicine is to be measured in part, but only in part, by the standard applied by the average man, namely, improvement, which, indeed, has been great, in the treatment of disease and injury. It is, however, its increasing power to check the incalculable waste of life, of energy, of money from preventable disease that places medicine today in the front rank of forces for the advancement of civilization and the improvement of human society. Economists and other students of social conditions have begun to realize this, but governments and the people are not half awake, and medicine, shaking off all mystery and with a sense of high public duty, has before it a great campaign of popular education.

The knowledge which has placed preventive medicine upon a sound basis and has given it the power to restrain and in some instances even to exterminate such diseases as cholera, plague, yellow fever, malaria, typhoid fever, tuberculosis and other infections, has come from exploration of the fields opened by Pasteur and by Koch. This power and the certainty of increasing it has given great strength to appeals for the endowment of medical research and the construction of laboratories. What is all the money ever expended for medical education and medical science compared with the one gift to humanity of Walter Reed and his colleagues of the Army Commission—the power to rid the world of yellow fever?

Great as has been the advance of medicine in the past half century, it is small indeed in comparison with what remains to be accomplished. Only a corner of the veil has been lifted. On every hand there are still unsolved problems of disease of overshadowing importance. The ultimate problems relate to the nature and fundamental properties of living matter, and the power to modify these properties in desired directions. Here our levers are far from the satisfactory fulcrum. But knowledge breeds new knowledge, and we cannot doubt that research will be even more productive in the future than it has been in the past. It would be hazardous in the extreme to attempt to predict the particular direction of future discovery. How unpredictable even to the most farsighted of a past generation would have been such discoveries as the principles of antiseptic surgery, antitoxins, bacterial vaccines, opsonins, the extermination of yellow fever or malaria by destruction of a particular species of mosquito, and many other recent contributions to medical knowledge!

The activities within the new buildings of the Harvard Medical School begin at a period of medical development full of present interest and full of hope for the future, and it may be confidently predicted that they will

have an important share in the onward movement, educational and scientific, of medicine.

One side of these activities will be devoted, under conditions most admirable as regards teachers, methods and opportunities, to the training of medical students and to advanced instruction. Supplemented by similar opportunities for under-graduate and advanced training in the hospital wards and dispensary, these conditions will be ideal.

The inspection of these noble new buildings, however, shows clearly that those who have planned them with such care, foresight and sagacity, while recognizing fully their important educational uses, have had also another and a main thought in their arrangements, namely, their adaptation to the purposes of original research. It is this dual function of imparting and advancing knowledge which justifies the expenditure of money and which insures a return of the capital invested in buildings, equipment, and operation with a high rate of interest in the form of benefits to mankind.

The most ample and freely available facilities are an important condition for productive research, but on this creative side of university work men count for more than stately edifice and all the pride and pomp of outward life. Research is not to be bought in the market place, nor does it follow the commercial law of supply and demand. The multitude can acquire knowledge; many there are who can impart it skillfully; smaller, but still considerable, is the number of those who can add new facts to the store of knowledge, but rare indeed are the thinkers, born with the genius for discovery and with the gift of the scientific imagination to interpret in broad generalizations and laws the phenomena of nature. These last are the glory of a university. Search for them far and wide beyond college gate and city wall, and when found cherish them as a possession beyond all price.

By the possession of investigators such as these, by the character and work of teachers and taught, by the advancement of knowledge and improvement of practice, may this new home of the Harvard Medical School be a center for the diffusion of truth in medicine, the abode of productive research, a fortress in the warfare against disease, and thereby dedicated to the service of humanity!

THE INTERDEPENDENCE OF MEDICINE AND OTHER SCIENCES OF NATURE[1]

Sixty years ago, when the American Association for the Advancement of Science was founded, all of the main divisions of the sciences of nature existed as they do today, but no greater change has come over the face of science during these years than the many subdivisions which have arisen. Then the naturalist or the natural philosopher—how unfamiliar even the names are beginning to sound!—or the chemist could follow with critical judgment at least the work of all who were cultivating his own broad field of science, and a single scientific association, such as ours, could unite all of the workers in the natural and physical sciences into a relatively homogeneous and compact group, supply their needs for intercourse with each other and furnish a comprehending audience for presentation of the results of scientific investigation. Today no man of science can pretend to follow all of the work even in his own department, and the investigator more often than not must seek an audience capable of critical understanding and discussion of his studies in a society of biological chemists, or of experimental zoologists, or of plant pathologists, or of dairy bacteriologists, or whatever may be the body which represents his own particular corner of science.

We may regret the loss of many charming features which have been erased from the landscape of science by all of this minute specialization, of which no one can foresee the end, but such a sentiment is much the same and as unavailing as that for the return of the days of the stage-coach. The great instruments of progress in modern life—steam and electricity in the industries, subdivision of labor and increasing specialization in science—are not altogether lovely, but they are the conditions of advancement in material prosperity and natural knowledge.

A necessary expression of the changed conditions of modern science has been the rapid formation of more and more highly specialized societies, which, it must be admitted, meet the personal needs of many individual workers more fully than a general association, representative of all the natural sciences, can possibly do. But the horizon of a man of science must indeed be narrowly circumscribed, if he cannot look beyond what he conceives to be his personal needs and the little plot of ground which he cultivates to those necessities of science as a whole which an organization such as ours is designed to serve. The common interests of science grow

[1] An address of the retiring president delivered before the American Association for the Advancement of Science, Chicago, December 30, 1907.

with its expansion, and the more minute and specialized its subdivision, the greater the need of an association representative of these common interests—a central, national organization which shall keep to the front the essential unity of all the sciences of nature and of man, and the vital importance to the welfare of the community of the extension and application of scientific knowledge in all directions.

In order to serve most efficiently these common interests of science the central organization requires from time to time readjustment in details of plan and working to changed conditions resulting from the development of science and national growth, but its underlying purpose remains always the same. This purpose is so fundamentally important that its attainment in the fullest measure possible by this association should secure the personal service, the active interest and the zealous loyalty of all scientific workers and lovers of science in this country. The association becomes a living organism through the devotion of its members to its interests and, when fired by this breath of life, the machinery of organization, otherwise inert, is made a powerful instrument for the advancement of science. Gratifying as has been the growth of the association in recent years in membership and usefulness, no one will claim that it has taken full possession of its rightful heritage. The membership of the association should be doubled, yes trebled, to secure needful additions to its resources and influence. The time is near, if it has not already arrived, when the association urgently needs a central office and the services of an executive officer and secretary sufficiently recompensed to enable him to devote his main time, thought and energies to the perfection of the organization, to the extension of membership, to the voluminous correspondence, to the arrangements for the meetings and to other manifold interests of the association. Familiarity with the benefits which such an arrangement has secured for the medical profession through the remarkably effective reorganization within recent years of the American Medical Association leads me to place the first emphasis upon this direction of improvement for the organization of science.

In speaking, as I have done, of modern science as subdivided and specialized, in order to indicate some of the problems relating to the organization of this association, there is danger of giving a false impression to those not fully informed of the actual conditions of science. In truth, the boundaries between the divisions and subdivisions of the sciences are being rapidly effaced by a deeper insight into the nature and phenomena of the material universe. Natural science has been compared to a continent separated into kingdoms, but a more appropriate comparison, it seems to me, is to the spectrum composed of different rays which merge imperceptibly

into each other and combine into one white light with radiant energy to be discovered beyond the limits of the visible.

Who will undertake in these days of physical chemistry to separate the domain of the physicist from that of the chemist? The problems of the geologist have long been recognized as essentially physical and chemical in their nature. An ever larger part of the biological sciences, including the medical, is opening to exploration and conquest by physical and chemical methods. To mathematics belongs the primacy, for the exactness of a science is in direct ratio to the degree with which its subject-matter can be investigated by measurement and calculation, that is by mathematical methods. The ideal thus implied has been fully attained only by celestial mechanics, but it is approached by some other departments of physics. It is in accord with this ideal that Priestley admirably said that the object of science is "to comprehend things clearly and to comprise as much knowledge as possible in the smallest compass." The ultimate problems of reality and of knowledge belong to metaphysics which we may, following Descartes, bury deep in the soil as the root of the tree of science.

While this mutual dependence of all the sciences of nature, so significant of the operation everywhere of common principles and forms of energy and of an underlying uniformity in the order of nature, both animate and inanimate, is closest between physical sciences in the restricted sense, it is strikingly illustrated in the history of the biological sciences, and it has seemed to me that the consideration of certain aspects of the interdependence of that department of biological science with which I am most familiar and the other sciences of nature would be an appropriate theme for an address by a representative of the science of medicine upon this occasion. It is to be understood that under the sciences of nature I include those of inanimate nature, the physical sciences, as well as those of organized beings, and indeed I shall dwell more particularly upon relationships between the medical sciences and physics and chemistry, for the points of contact between the various branches of biological science and medicine are self-evident and more familiar.

It need hardly be said that any systematic and full consideration of this broad theme far transcends the limits of an address and that in selecting particular aspects of the subject and certain illustrations I am quite aware that other points of view and other examples will come to the minds of my hearers as equally, if not more, worthy of presentation. Medicine has derived such inestimable benefits from the physical and natural sciences that I desire to lay some emphasis upon the services which it has rendered to them. For my present purpose it is not necessary to assign any limits to the operation of physical and chemical laws in living beings, for the most

extreme vitalist must leave so large a part of the phenomena of living beings under the subjection of these laws that their application in medical and biological studies must always be of the highest importance.

An historical sketch, necessarily brief and inadequate, of some of the principal phases in the reciprocal relations between medicine and the physical sciences, up to the time when the latter became fully independent at the close of the seventeenth century, will show with what propriety medicine has been called the "mother of the sciences."

Physical science has derived from the Greeks no such extensive records of sound observation and experience as those which medicine has inherited from the writings of Hippocrates and his followers. Physical theories embodied in the speculations of the nature-philosophers concerning the constitution and properties of matter furnished the starting point for the Hippocratic doctrine of the four humors and other generalization, but these theories sat so lightly upon Hippocrates that his name is attached to that method of medical study which rejects dogma, authority and speculation and confines itself to the observation and record of clinical facts. As Gomperz in his admirable work on the "Greek Thinkers" has clearly pointed out the age of enlightenment in scientific thought was inaugurated by Hippocrates and his medical contemporaries.

The influence of physical theories upon medical thought in antiquity can be traced not only in the humoral doctrines of Hippocrates and of Galen, but also in rival schools, and especially in the so-called methodic school founded upon the atomistic philosophy of Democritus, which is so interesting in the history of scientific theories. As this school produced such admirable physicians as Asclepiades, Soranus and Aretaeus it is to be regretted that their solidistic pathology was so completely displaced by the authority of Galen.

The large body of medical knowledge and doctrine which had grown up during the six centuries since Hippocrates was further developed and fixed by Galen at the end of the second century after Christ into a system not less complete in its field, nor less satisfying to the minds of men for nearly fifteen centuries, nor scarcely less remarkable as a product of the human mind than the physical and philosophical systems of Aristotle. Within their respective spheres the system of doctrine of each of these great men has exerted a similar dominating influence upon human thought and has met a similar fate through influences almost identical.

Although the contributions of the Greeks to mathematics were of the highest order, and the names of Aristarchus, Eratosthenes, Hipparchus and Ptolemy attest the great debt of astronomy to the school of Alexandria, and Archimedes had founded one branch of mechanics, and the works of Aristotle

on "the history" and on "the parts of animals" entitle him to be called the "father of zoological science," I think that it is safe to say that the largest body of ordered natural knowledge in any single domain bequeathed by the ancients to posterity was represented by medicine. The botanists trace the beginnings of their science to the physicians, Theophrastus and Dioscorides, but botany was then, as it long remained, an integral part of pharmacy.

As medicine, practically in the shape in which it left the hands of Galen, continued for many centuries to be the shelter for most of the natural sciences, it is worth considering how worthy a home it furnished. For this purpose it is not necessary to enter into details of doctrine or even the state of existing knowledge. A few words concerning the general scope and spirit of medicine, as conceived and transmitted by the Greek physicians, must suffice.

Gomperz formulates the ideal of these physicians as regards their conception of the relation of medicine to the philosophy of nature in these words:

"The human being is a part of the whole of nature, and can not be understood without it. What is wanted is a satisfactory general view of the process of the universe. Possessing this, we shall find the key in our hand which will open the most secret recesses of the art of medicine."

Certainly such an enlightened conception of the relations of medicine, however unattainable it may be, is broad enough to provide welcome lodging under the roof of the healing art to any additions to the knowledge of nature. Although priestly and magic medicine and charlatanry existed then by the side of rational medicine, as they have always done, the Galenic system, which was a development of the Hippocratic, was in essence observational and inductive, mainly physical, as distinguished from vitalistic, and nearly devoid of superstition and the supernatural. Galen conceived medicine as a science and constituted anatomy and physiology its basis. He himself made valuable use in his physiological studies of the method of experiment, the singular and almost unaccountable lack of which is largely responsible for the fantastic, though often singularly prophetic, ideas and the sterility of the Greek natural philosophers as contributors to natural knowledge. Although later cultivators of the domain of medicine followed far behind these ideals of Greek medicine, there survived enough of their spirit to enable us to understand why the sciences of nature were for so long a time fostered within this domain, which furnished them a fitting and no unworthy abode until they were strong enough to build their own homes.

Although the Byzantine, Arabic and Mediaeval periods afford a number of interesting illustrations of my theme, I shall not take time to consider them,

for these periods were relatively unproductive for most of the sciences as well as for medicine. It may be noted, however, that the majority of the names which appear in the histories of the various natural sciences for these times figure also in the history of medicine.

The great awakening of western Europe, marked by the revival of learning and the reformation, stirred the long dormant spirit of inquiry and led to revolt against authority, a fresh outlook upon a wider world, the study of original sources, the questioning of nature at first hand and the search for new knowledge in all her kingdoms. The seat of learning was transplanted from the cloisters to the universities, which multiplied and flourished in the sixteenth and seventeenth centuries as never before.

For medicine and the sciences of nature the fire was kindled and for two centuries burnt brightest in the universities of northern Italy. Here the science of human anatomy was reformed and marvelously developed by Vesalius and an illustrious line of successors in the sixteenth century, and from this period onward anatomy never ceased to be taught by practical dissection, that is to say, by the method of the laboratory. It deserves to be emphasized that for over two hundred and fifty years human anatomy was the only subject taught in the universities by the laboratory method and that it thereby acquired a commanding position in the study of medicine. Bearing in mind the exceptional educational value thus imparted to the study of anatomy and that for a long time medicine was the only technical subject taught in the universities, we can not doubt that under conditions existing previous to the nineteenth century the study of medicine furnished the best available training for the pursuit of any branch of natural science. From his practical anatomical work the student could acquire the habit of close observation, manual dexterity and the sense for form in nature, and learn that real knowledge comes only from personal contact with the object of study. The term "comparative anatomy," even if it serves no other useful purpose, at least points to the historical fact that human anatomy was the starting point and basis of comparison for the morphological study of the lower animals.

In the sixteenth century practically all of the valuable contributions to botany and to zoology were made by physicians, so that natural history scarcely existed apart from medicine. Of the medical contributors to botany it must suffice to mention the names of Brunfels, Fuchs, Dodoens, Gesner and above all Cesalpinus, who has been called "the founder of modern scientific botany," the most important name before John Ray in the history of systematic botany, and a distinguished figure likewise in medical history. Of names associated with the history of zoology in this century the most important are those of the physicians, Conrad Gesner, a marvel of encyclo-

paedic learning, and Aldrovandi, who ranks with the founders of modern zoology and comparative anatomy; of lesser lights Edward Wotton may be singled out for mention as the pioneer English zoologist. He was doctor of medicine of Padua and of Oxford, president of the Royal College of Physicians, and physician to Henry VIII.

A name of first rank in the history of science is that of the physician, Georgius Agricola, who founded before the middle of the sixteenth century the science of mineralogy and developed it to a state where it remained for nearly two hundred years without important additions. I may here remark in passing that the first American chair of mineralogy was established in 1807 in the College of Physicians and Surgeons of New York and was occupied by Dr. Archibald Bruce, a name familiar to mineralogists, the founder of the first purely scientific journal in this country, the "American Journal of Mineralogy," which was the immediate predecessor of Silliman's "American Journal of Science."

The difficult step from Hippocrates and Galen to Euclid and Archimedes was surmounted by several physicians of the sixteenth century, as it has also been repeatedly in later times. The reader of Don Quixote will recall that as late as the seventeenth century the physician was also called "*algebrista*" in Spain, a survival of a Moorish designation—and the sixteenth-century physicians Geronimo Cardano, as extraordinary a figure in the history of medicine as in that of mathematics, and Robert Recorde, the author of the first treatise on algebra in the English language, exemplified the union of the healing art with the pursuit of mathematics as strikingly as did the Sedbergh surgeon, John Dawson, in the latter part of the eighteenth century, who had eight senior wranglers among his pupils and was one of the few British analysts of the period who could follow the work of the great contemporary, continental mathematicians. It may here be mentioned that the celebrated Bernoulli family of mathematicians, two of the most distinguished, John and Daniel, were doctors of medicine, the latter being for a time professor of anatomy and botany at Basel.

The student of medical history, who takes up a history of physics, such as that of Rosenberger, will probably be surprised to find how many of the contributors to the latter subject in the sixteenth century were physicians and that among these are such old friends as Fernel and Fracastorius, whom he has identified so intimately with the annals of his profession. It is to be presumed that he already knew that the most famous of all, Copernicus, was a doctor of medicine of Padua and practised the medical art gratuitously among the poor in Frauenburg.

Far more important for the subsequent history of science than any relations between medicine and physics at this period was the union between

medicine and chemistry effected by Paracelsus and strengthened by van Helmont and Sylvius in the following century, a union so intimate that for nearly a century and a quarter chemistry existed only as a part of medicine until freed by Robert Boyle from bonds which had become galling to both partners. The story of this iatrochemical period, as it is called, has been told by Ernst von Meyer in his fascinating "History of Chemistry" in a way not less interesting to the student of medicine than to that of chemistry, and should be there read by both.

In reply to the question what benefit accrued to both medicine and chemistry from their mutual interaction during this period von Meyer says:

"The answer is, a mutual enrichment, which did almost more for chemistry than for medicine; for the former was raised to a higher level through being transferred from the hands of laboratory workers, who were mostly uneducated, to those of men belonging to a learned profession and possessing a high degree of scientific culture. The iatrochemical age thus formed an important period of preparation for chemistry, a period during which the latter so extended her province that she was enabled in the middle of the seventeenth century to stand forth as a young science by the side of her elder sister, physics."

Paracelsus in carrying out his program that "the object of chemistry is not to make gold but to prepare medicines" made the pharmacist's shop a chemical laboratory and until the establishment of laboratories by Thomas Thomson and by Liebig in the first quarter of the nineteenth century this continued to be the only kind of laboratory available for practical training in chemistry. Through this portal entered into the domain of chemistry Lemery, Kunkel, Marggraf, Klaproth, Scheele, Proust, Henry, Dumas and many others. Liebig, who also began as an apothecary's pupil, has graphically described these conditions.

That strange, iconoclastic genius, Paracelsus, typifies, as no other name in science, the storm and stress, the strife, the intellectual restlessness and recklessness of the sixteenth century which prepared the way for the glorious light of science which illuminated the following century. With boundless enthusiasm minds, now fully liberated from the bondage of authority, entered upon new paths of philosophical thought and scientific discovery and achieved triumphs unequaled even in the nineteenth century. The great achievement was the full recognition and the fruitful application of the true method of science in all its completeness.

Although isolated and limited use had been made of the method of experiment in former times—I have already cited Galen and I might have added physicians of the Alexandrine school—the real birth of experimental science was toward the end of the sixteenth and the beginning of the seventeenth centuries. Medicine can hardly be said to have presided at this birth, but its

influence was not absent. Galileo was a student of medicine, one of his teachers being the celebrated physician and botanist, Cesalpinus, when in 1583 he watched the great bronze lamp swinging before the high altar of the Cathedral of Pisa, and I question whether it would have occurred to anyone without some interest in medicine to determine the isochronism of the pendulum by counting the beats of the pulse. It seems improbable that without his medical training Galileo would have made the measurement of the pulse the first application of the new principle and have called the instrument the pulsilogon. Nevertheless we must bear in mind that natural philosophers of this period and throughout the seventeenth century were greatly interested in anatomy and physiology. Dr. Weir Mitchell in an address, as charming as it is erudite, has called attention to interesting observations of Kepler on the pulse, which the great astronomer believed to have some relation to the heavenly motions, in this and certain other views exemplifying, as some modern physicists have done, the compatibility of a firm hold of positive scientific truth with an irresistible tendency to mysticism and occult science. Kepler was not, as has been stated, the first actually to count the pulse, for we read that as long ago as the Alexandrine period Herophilus timed the pulse with a water-clock.

But if Galileo was only half a doctor of physic, as Dr. Mitchell calls him, his elder contemporary, William Gilbert, second in importance only to Galileo among the creators of experimental science, the founder of the science of magnetism and a significant name in the history of electricity, was fully identified with the profession, being the most distinguished English physician as well as man of science of his day, physician to both Queen Elizabeth and James I., and president of the Royal College of Physicians.

Galileo's younger contemporary, William Harvey, the discoverer of the circulation of the blood, occupies in the history of experimental science an independent position, quite unlike that of the other experimental physiologists of the century. These other physicians, as Sanctorius, Borelli, Lower, Mayow, consciously took possession of the method of experiment as a powerful and newly discovered instrument of research and were swayed in all their physiological work by the discoveries of the physicists. Not so Harvey, who was influenced but little by contemporary physical science and is linked on, not to Galileo or to Gilbert, as exemplars of experimentation, but in a very direct way to the experimental physiologist, Galen, and to Aristotle, as well as to the Italian anatomists of the preceding century. Harvey's genuinely scientific mind was in greater sympathy with Aristotle than with the essentially unscientific Lord Bacon, who was his patient and of whom he said, "He writes philosophy like a Lord Chancellor."

There is no more striking characteristic of seventeenth-century science than the wide range of inquiry covered by individual investigators. The

natural sciences were no longer apprenticed to medicine, after Boyle had liberated chemistry, but the problems of anatomy, of physiology and even of practical medicine were not separated from those of the natural philosopher and of the naturalist. With unparalleled versatility every one seemed to roam at will over the whole domain of knowledge and thought. How they leaped and tumbled in the virgin fields and hied "tomorrow to fresh woods and pastures new"!

Descartes was an anatomist and physiologist as well as philosopher, mathematician and physicist, and John Locke, the other great liberator of thought in this century, was educated in medicine, practised it and, like Boyle, accompanied Sydenham on his rounds. Kepler studied the pulse, contributed to physiological optics and calculated the orbits of the planets. Borelli was an important mathematician, physicist and astronomer, as well as one of the greatest physiologists and physicians of the century. Bartholinus was also professor of mathematics as well as of medicine, and discovered the double refraction of Iceland spar. His even more remarkable pupil, Steno, left a name memorable in geology and paleontology as well as in anatomy and physiology, and died a bishop of the Roman Catholic Church. Mariotte, a pure physicist, discovered the blind spot in the retina. Boyle anatomized, experimented on the circulation and respiration, started chemistry on new paths and perpetuated his name in attachment to an important physical law. Hooke, most versatile of all, claimed priority for a host of discoveries, and did in fact explore nearly every branch of science with brilliant, though often inconclusive results. Malpighi was an investigator equally great in vegetable and in animal anatomy and physiology, and what a glorious time it was for the microscopists, like Malphighi, Leeuwenhoek, Swammerdam and others, who could immortalize their names by turning the new instrument on a drop of muddy water, or blood, or other fluid, or a bit of animal and vegetable tissue! From the funeral sermon upon Nehemiah Grew, practitioner of physic and one of the founders of vegetable anatomy and physiology we are assured that he was "acquainted with the theories of the heavenly bodies, skilled in mechanicks and mathematicks, the proportions of lines and numbers, and the composition and mixture of bodies, particularly of the human body" and also "well acquainted with the whole body of Divinity and had studied Hebrew to more proficiency than most divines."

The early proceedings of the various scientific societies and academies, started in this century and destined to become powerful promoters of science, afford excellent illustrations of the wide scope of scientific inquiry. A quotation from the narrative of the famous mathematician, Dr. Wallis, gives further evidence of the position of the medical and other sciences in

the aims and work of the little band of thoughtful students of nature who assembled in Oxford in 1645 and later in London, constituting the so-called invisible college, which grew into the Royal Society. He says:

"Our business was (precluding matters of theology and state affairs) to discourse and consider of philosophical enquires and such as related thereto—as Physick, Anatomy, Geometry, Astronomy, Navigation, Staticks, Magneticks, Chymicks, Mechanicks and Natural Experiments; with the state of these studies and their cultivation at home and abroad. We then discoursed of the circulation of the blood, the valves in the veins, the venae lacteae, the lymphatic vessels, the Copernican hypothesis, the satellites of Jupiter, the oval shape (as it then appeared) of Saturn, the spots on the sun and its turning on its own axis, the inequalities and selenography of the moon, the several phases of Venus and Mercury, the improvement of telescopes and grinding of lenses for that purpose, the weight of air, the possibility or impossibility of vacuities and nature's abhorrence thereof, the Torricellian experiment in quicksilver, the descent of heavy bodies and the degree of acceleration therein, with divers other things of like nature."

The work and publications of the small group of physicians and men of science composing the Accademia del Cimento which was established in Florence in 1657 and flourished unfortunately for only ten years, exemplify in an equally striking manner the combination of medical with other scientific pursuits and the wide range of study.

Borelli, the most important member of this academy, founded the so-called iatrophysical school of medicine, which contested the field for supremacy with the iatrochemical, to which I have already referred, during the greater part of the seventeenth century. The story of these two schools is epochal and occupies the larger part of the history of physics during this century. Medicine owes to adherents of each school a large debt for important contributions to the knowledge and fresh directions of thought. Where physical methods and knowledge, as they then existed, were applicable, as in investigation of the circulation and of the action of muscles, the iatrophysicists carried off the palm, Borelli's "De motu animalium" being one of the medical classics. But notwithstanding the great inferiority of chemistry to physics at this time the paths of discovery opened, although not traveled far, by the iatrochemists have led to more important results. The beginnings of our knowledge of digestion and of secretion and even of the chemistry of the blood and other fluids are to be traced in the main to the iatrochemical school, and the study of fermentation, although this was not conceived in the same sense as today, of gases, salts, acids and alkalis was of importance to medicine as well as to chemistry.

There never has been a period in medical history, not even in recent years, when so determined an effort was made to convert medicine into applied physics and chemistry as that in the seventeenth century. Descartes's

dualistic philosophy, which left no more room for the intervention of other than mechanical forces in the organized world than in the inorganic, had great influence upon the minds of physicians as well as of physicists. Galileo had founded, and a line of great experimental philosophers from him to Newton had vastly extended, the science of dynamics, which then seemed to many, as in potentiality it may be, as applicable to all the activities of living beings as to the inanimate universe. There came in the first quarter of the century the greatest physical discovery in the history of physiology, that of the circulation of the blood, which opened the large biological tract of haemodynamics to rewarding study by the new physical methods. The balance, the pendulum-chronometer, the thermometer and other newly invented instruments of precision were turned to good account in anatomical, physiological and pathological investigations, and physicians began to count, to weigh, to measure, to calculate and to discover a world of form and structure hidden from their unaided vision. Such chemistry as existed was pursued almost exclusively by physicians and primarily in the interest of medicine.

What wonder, then, that physicians who came under the influences of this great awakening in physical science and took no small part in its advent and promotion, should have entertained hopes, soon doomed to disappointment, of the benefits to medicine from application of the new knowledge and have promulgated hypotheses and systems of doctrine which seem to us so false and extravagant! Great as was the advance in physical knowledge, it was utterly inadequate for many of the purposes to which the iatrophysicists and iatrochemists applied it, and to this day many of their problems remain unsolved.

Grateful we should be for valuable discoveries and new points of view which medicine owes to these men, often so unjustly criticized, but the time had come for men of our profession to resume the Hippocratic method of collecting facts of observation within their own clinical field, and Syndenham, of all the physicians of his century the name, next to Harvey's, most honored by medical posterity, in calling out, "back to Hippocrates!" turned the face of medicine again toward nature.

There are interesting points of comparison between Sydenham's position in the history of medicine, and that of his fellow-countryman and contemporary, John Ray, in natural history. I am sorry that my profession, which has fostered so many ardent students of nature, including Linnaeus and Agassiz, the respective bi-centenary and centenary anniversaries of whose birth have been celebrated with such enthusiasm in the year now closing, cannot claim this greatest naturalist of his century. Both Sydenham and Ray stood apart from the great scientific movement of their day; both,

little influenced by theory or tradition, concentrated their effort strictly within their respective fields of observation, and both introduced new methods of studying their subjects. As Ray, the plants and animals, so Sydenham described diseases as objects of nature, his discriminations and descriptions being in several instances the first, and to this day in some cases unsurpassed and unimpaired by new knowledge. Like Ray, he was not a mere species-monger, but he had the synthetic power to assign the proper place to single observations and to combine them into well ordered groups. By way of contrast, the attempt of Linnaeus to classify diseases into species and genera, although of some historical interest, was utterly barren, the subject-matter permitting no such method of approach as that which enabled this great systematist to start a new epoch in botany and zoology.

With the close of the seventeenth century we reach a dividing line, which limitations of time compel me to make on this occasion a terminal one, in the historical survey of the interrelations of medicine and the natural sciences. I cannot, however, refrain from at least the bare mention of the influence of physicians on the development of science in America—a theme which I hope on some other occasion to take up more fully. Leonard Hoar, doctor of medicine of Cambridge, England, brought something of the new experimental philosophy to America, and during his short incumbency of the presidency of Harvard College (1672-1674) planted the first seeds of technical training on American soil, but too early for them to germinate. Of much greater importance was Cadwallader Colden, an Edinburgh doctor, acquainted with the Newtonian mathematics and physics, and a botanist of note in his day, who did much to instill an interest in physical and natural science among physicians and others in Philadelphia and New York in the first half of the eighteenth century. Besides John Bartram, who studied and to some extent practised physic, the founder on the banks of the Schuylkill of the first botanical garden in this country, there is a long line of American medical botanists, as Clayton, Colden, Mitchell, Garden, Kuhn, Wistar, Hosack, Barton, Baldwin, Bigelow, Torrey, the teacher and collaborator of Asa Gray, himself a graduate in medicine, Engelmann, whose names are perpetuated in genera of plants, and many others up to this day. Until the coming of Agassiz, who trained many who did not enter medicine (although among his pupils were also not a few medical men, including the Le Contes and A. S. Packard), most of the zoologists were also physicians, and Agassiz found already at work in his field in Boston the physicians, Gould, Storer, Harris, and one worthy of a place by his side, Jeffries Wyman. Of the delightful naturalist type of physician there have been many, such as Samuel Latham Mitchill, John D. Godman, Jared Kirt-

land, and above all a man who belongs to the world's history of biological and paleontological science, Joseph Leidy, whose monument was recently dedicated in Philadelphia. Geologists will call to mind such names as Gibbs, Newberry, John Lawrence Smith, also a chemist and mineralogist, and the Le Contes; and ethnologists the names of Samuel G. Morton, Daniel G. Brinton and Edward H. Davis. How many of the Arctic explorers from this country, as Kane, Parry, Hayes, Schwatka, as well as from England, have been physicians! There have been many whose interest in science was first awakened by the study of medicine, but who were not graduated as doctors, as Joseph Henry, Sears Cook Walker, Thomas Sterry Hunt and Spencer F. Baird. Particularly interesting as investigators in physical science were members of the medical families of the Drapers, the Le Contes and the Rogers. This bare mention of a few of the American medical contributors to science, mostly of an earlier period, will perhaps afford some indication of the services of medicine to scientific development in this country.

After the seventeenth century in Europe the natural sciences, though often cultivated by those educated in medicine and practising it, were independent and followed their own paths, which, however, communicated by many by-ways with the road of medicine and with each other.

Botany and zoology acquired their independent position probably more through the work of Ray and Willughby than by that of any other naturalist. Botany, however, remained for over a century still mainly in the hands of physicians. An interesting chapter in its history is the story of the various apothecaries' and other botanical gardens established through the efforts of physicians and conducted by them primarily for the study of the vegetable materia medica. From such beginnings has grown the Jardin des Plantes in Paris, started by two physicians, Herouard and la Brosse, in 1633, into the great museum of natural history made by Buffon, Cuvier and others as famous for the study of zoology as by Brongniart and his successors for botany. Less humble was the foundation of the British Museum and its appanage, the great Museum of Natural History in South Kensington, the gift to the nation of his valuable collections in natural history and other departments by Sir Hans Sloane, a leading London physician in the first half of the eighteenth century.

Boyle's name is associated especially with the foundation of chemistry as a separate science. William Cullen deserves to be remembered in the history of this science, who, although not an important contributor to chemistry as he was to medicine, was in the second half of the eighteenth century the first to raise the teaching and study of chemistry to their true dignity in the universities of Great Britain, and imparted the first stimulus to his pupil and successor in the Edinburgh chair of chemistry, William Black.

Mechanics, never really dependent upon medicine, was lifted by Newton to analytical heights, rarely scaled by disciples of Aesculapius, although, as Thomas Young and Helmholtz have exemplified, not wholly beyond their reach. But not all of physics stands on the lofty plane of abstract dynamics constructed by Newton, Lagrange, Laplace and Gauss, the highest probably hitherto attained by the human intellect. There have been many educated in medicine who have made notable contributions to the physics of sound, heat, light, magnetism, electricity and the general properties of matter and energy. I have collected, without any pretence to exhaustiveness, the names of over a hundred physicians or men trained for the practise of medicine or pharmacy who have made contributions to physics sufficiently notable to secure them a place in the history and records of this science. A few of the more important are Gilbert, van Musschenbroek, Sir William Watson, Black, Galvani, Berthollet, J. W. Ritter, Olbers, Wollaston, Thomas Young, Oersted, Dulong, Mayer, Thomas Andrews, Sainte-Clair Deville, the Drapers, Foucault, Helmholtz. Sir Humphry Davy literally sprang out of the lap of medicine into the Royal Institution, just founded by Count Rumford, who himself had begun the study of medicine before he left his native country. If the surgeons of England at that time had only heeded what Davy told them concerning the anesthetic properties of nitrous oxide gas, America would have been deprived of the greatest service which she has rendered to medicine.

In the long line of important physiologists of the past century who represent especially the physical direction of investigation in their important branch of medicine and biology, there are not a few whose names find a place in the histories of modern physics, as E. H. Weber, Du Bois Reymond, von Brücke, Ludwig, Fick, Vierordt, Poiseuille and others, and the studies of the botanists, Pfeffer and de Vries, on the turgor of vegetable cells opened an important field of physical chemistry.

Aspects of my subject, full of interest, which I can now barely touch upon, are the influence of previous medical or biological training upon the work of a physicist or chemist, and closely connected with this the extent to which purely physical problems have been approached from the biological side. Call to mind how the central physical and chemical problem of the eighteenth century, the nature of combustion, was throughout this period intimately associated with the kindred physiological problem of respiration, and how John Mayow in the seventeenth century, approaching the subject from the biological side, reached a conclusion in accord with that fully demonstrated a century later by Lavoisier, who thereby opened a new era for physiology as well as for chemistry. For the first time clear light was shed upon the function of respiration, the nature of metabolism and the

sources of animal heat, and such physical interest was attached to the study of these physiological phenomena that physicists of the rank of Laplace, in association with Lavoisier, Dulong, W. E. Weber, Magnus, A. C. Becquerel, Hirn, Regnault, and of course Helmholtz, have all made valuable contributions to the elucidation of these subjects.

The study of electricity, especially after the physiologist, Galvani's epochal discovery, more correctly interpreted by Volta, engaged the attention of physicians and physiologists scarcely less than that of physicists. The latter became greatly interested in animal electricity, a subject partly cleared up by the physicists, Ritter and Nobili, but mainly by the physiologist, Du Bois Reymond. Ostwald points out, as a matter of interest in the history of the human mind, that the physician Soemmerring was led to conceive of the transmission of intelligence by electricity from analogy with the conveyance of impulses by the nerves, and thus to invent his practically useless form of the electric telegraph. However fanciful such a relationship may be, it is interesting, as Sir David Brewster discovered, that the first proposal for an electric telegraph worked by statical electricity was made and actually carried into effect as early as 1753 by the Greenock surgeon, Charles Morrison. It is now well understood that no one has the sole credit of inventing the electric telegraph, the idea of which was implicit in Stephen Gray's observation in 1727 of the transmission of electricity by a wire.

Of curious interest is the introduction of electricity for the treatment of disease by the physicists, Kratzenstein, Nollet and Jallabert, shortly before the middle of the eighteenth century, who reported cures by its use.

There is no more striking illustration of the correlation of two apparently distinct lines of approach to the same problem than the attack from the biological and from the purely physical sides upon the thermo-dynamic problem, which is as fundamental for biology as for physics. The conception of the principle of conservation of energy was supplied independently and almost simultaneously on the one hand by students of the conditions of mechanical work done by the animal machine and on the other hand by investigators of technical machines. Much of the essential preliminary study was on the biological side by Boyle, Mayow, Black and Lavoisier. Mainly from the same side the physician and physicist, Thomas Young, first formulated the modern scientific conception of energy as the power of a material system to do work. Davy and Rumford contributed, and from the physiological side Mohr, Mayer and Helmholtz, and from the purely physical side, after preliminary work by Poncelet and Sadi Carnot, Joule, Thomson and Clausius reached the same grand conception.

The first to enunciate clearly and fully the doctrine of the conservation of energy and to measure the unit of mechanical work derived from heat was the physician, J. R. Mayer. Joule's work completed the demonstration, but Mayer's name is deservedly attached to this principle by Poincaré and others, as Lavoisier's is to that of the conservation of mass, and Sadi Carnot's to the principle of degradation of energy. As regards this last principle it is almost as interesting to biologists as to physicists that in the so-called Brunonian movement, discovered by the physician and more eminent botanist, Robert Brown, and the subject of interesting physical investigations in recent years, we behold an apparent exception to the principle of degradation of energy, such as Clerk Maxwell pictured as possible to the operations of his sorting demon.

I must forego further citation of examples of this kind of correlation between the work of physicists and of physiologists, and leave untouched the chemical side, which is much richer in similar illustrations. The significance to organic chemistry of the synthesis of urea by Wöhler, and to agricultural chemistry of the bacteriological studies of nitrification in the soil and fixation of nitrogen in plants, will perhaps indicate how large and fascinating a field I must pass by.

The great advances in physics and chemistry initiated in France toward the end of the eighteenth and beginning of the nineteenth century were quickly reflected upon the medical and biological sciences through influences which in large part are attributable to this new movement in physical science. New methods of physical examination of the patient were introduced, and pathology and experimental and chemical physiology were developed as biological sciences of the first rank. This reformation of the medical sciences in the first third of the nineteenth century was mainly the work of Frenchmen, the great names in this development being those of Lavoisier, Bichat, Laennec and Magendie, the last a friend and physician of Laplace, and contemporary of Cuvier, who represented a like movement in zoology. Liebig, the pupil of Gay-Lussac and founder of biological chemistry as a distinct science, carried in the third decade of the century the new spirit to Germany, where Johannes Müller and his pupils became the center of a movement which rescued medicine and biology from the shackles of the philosophy of nature and has given Germany the supremacy in these fields of science. The experimental physiological work of the brothers Weber, two being physicians and the third the great physicist who was so intimately associated with Gauss in Göttingen, was of great influence in introducing the physical direction of physiological research, but Magendie stands first in making the experimental method the corner-stone of normal and pathological physiology and pharmacology.

Most pertinent to my theme is it to note that the light which has transformed the face of a modern practical medicine came in the first instance not from a physician but from a physicist and chemist Pasteur. The field of bacteriological study was placed on a firm foundation and thrown open to ready exploration by Robert Koch, and thereby that class of diseases most important to the human race, the infectious, became subject in ever increasing measure to control by man. Thus hygiene and preventive medicine, through their power to check the incalculable waste of human life and health and activities, have come into relations, which have only begun to be appreciated, with educational, political, economic and other social sciences and conditions, and with the administration of national, state and municipal governments. It is an especial gratification to record the stimulating recognition of these relationships by the social and economic section of this association in which was started a year and a half ago a movement for public health, particularly as related to the federal government, which has already assumed national significance.

To the marvelous growth of the medical and other sciences of living beings during the past century, and especially in the last fifty years, physics and chemistry and the application of physical and chemical methods of study have contributed directly and indirectly a very large and ever increasing share. In many instances there is no telling when or where or how some discovery or new invention may prove applicable to medical science or art. Who could have dreamed in 1856 that Sir William Perkin's production of the first aniline dye should be an essential link in the development of modern bacteriology and therefore in the crusade against tuberculosis and other infectious diseases? As Robert Koch has said, it would have been quite impossible for him to have developed his methods and made his discoveries without the possession of elective dyes for staining bacteria, and no other class of coloring agents has been discovered which can serve as substitutes for the anilines in this regard. And how much assistance these dyes have rendered to the study of the structure and even the function of cells! If we trace to their source the discovery of Röntgen's rays, which have found their chief practical application in medicine and surgery, we shall find an illustration scarcely less striking.

No important generalization in physical science is without its influence, often most important, upon biological conceptions and knowledge. I have already referred to the great principles of conservation of mass and of energy which are at the very foundation of our understanding of vital phenomena. Although we can not now foresee their bearings, we may be sure that the new theories, regarding the constitution of what has hitherto been called matter, will, as they are further developed, prove of the highest

significance to our conceptions of the organic as well as of the inorganic world. Clerk Maxwell in his article on the atom in the ninth edition of the Encyclopaedia Britannica, on the basis of a computation of the number of molecules in the smalest organized particle visible under the microscope, reached a conclusion which he states in these words:

"Molecular science . . . . forbids the physiologist from imagining that structural details of infinitely small dimensions can furnish an explanation of the infinite variety which exists in the properties and functions of the most minute organism."

Larmor, in the tenth edition of the same work in his article on the ether, points out that upon the assumption of either vortexatoms or electric atoms physical science is concerned only with the atmosphere of the atom, that is with the modification impressed on the surrounding ether, whereas the nucleus or core of the atom may perhaps be taken into account in the problems of biology, although it would appear that nothing can be known of this nucleus. With still later developments of the dynamical hypothesis, which resolves matter into nothing but activity or energy, there are those who think that the hard knot of ages is to be untied and the animate and inanimate worlds come together under a satisfying monistic view of the whole as in essence active energy.

The ultimate problems of biology reside in the cell. Whatever the future may hold in store, at the present day only a relatively small part of these problems are approachable by physical or chemical methods, and the day is far distant, if it ever comes, when cellular physiology shall be nothing but applied physics and chemistry. We cannot foresee a time when purely observational and descriptive biological studies, which today hold the first place, shall not continue to have their value. They represent the direction which makes the strongest appeal to the great majority of naturalists. The broadest generalizations hitherto attained in biology, the doctrine of the cell as the vital unit and the theory of organic evolution, have come from this biological, as distinguished from physical, direction of investigating living organisms, and were reached by men with the type of mind of the pure naturalist, who loves the study of forms, colors, habits, adaptations, inheritances of living beings.

It is well that the sciences of nature hold out attractions to so many different types of mind, for the edifice of science is built of material which must be drawn from many sources. A quarry opened in the interest of one enriches all of these sciences. The deeper we can lay the foundations and penetrate into the nature of things, the closer are the workers drawn together, the clearer becomes their community of purpose, and the more significant to the welfare of mankind the upbuilding of natural knowledge.

FIELDS OF USEFULNESS OF THE AMERICAN MEDICAL ASSOCIATION[1]

I wish to offer my hearty thanks for the signal honor of election to the presidency of this association—an honor to which no member of our profession can be indifferent as a mark of the esteem and confidence of his colleagues and a high office of privilege and opportunity. The bestowal of this honor on one not engaged in the practice of medicine I interpret as a conspicuous recognition of the importance of those sciences on which this practice is founded.

In the recent death of Robert Koch the world mourns the loss of one of the greatest scientific investigators and benefactors of his race of all time—one who shares with Pasteur the immortal distinction of founding and developing the modern science of bacteriology, and establishing the germ theory of infectious diseases, which has had a revolutionary influence on practical and especially preventive medicine. To him we owe not only the introduction of the methods which have made possible the great discoveries in this field, but also the most fruitful exploration of the domain whose gates he had unlocked.

Since our last annual session there have passed away many eminent in our profession who have been identified with the work of this association. Of those honored by the association with high office, the especial tribute of our respect and grateful appreciation is due to the memories of Dr. Herbert L. Burrell, a recent president of the association, distinguished surgeon and public spirited citizen, to whom so much of the remarkable success of our sessions in Boston and Chicago was due, and of Dr. William Biddle Atkinson, the permanent secretary of this association from 1864 to 1899—more than half the years of its existence—and for much of this time the editor of the " Transactions."

To the honored roll of martyrs to medical science has been added recently the name of Dr. Howard Taylor Ricketts, who died in the City of Mexico from typhus fever, with which has was stricken while engaged in its investigation.

Aided partly by grants from the committee on scientific research of this association, Dr. Ricketts, by his important investigations, especially of

[1] President's address delivered at the Sixty-first Annual Session of the American Medical Association, St. Louis, June 7, 1910.

J. Am. M. Ass., Chicago, 1910, LIV, 2011-2017.

Rocky Mountain fever and Mexican typhus, had acquired a place in the front rank of American pathologists. Scientific medicine in this country has suffered a serious loss by the untimely death of this brilliant young investigator.

Monument to Yellow Fever Commission

As it has always been the endeavor of this association to secure suitable recognition of our medical heroes, we welcome with keen satisfaction the action of Senator Owen in introducing a bill in Congress, in line with a previous recommendation of President Roosevelt, appropriating the sum of fifty thousand dollars for a monument in Washington in honor of the Yellow Fever Commission, composed of Major Walter Reed, Dr. James Carroll, Dr. Jesse W. Lazear and Dr. Aristides Agramonte, and commemorating also the men who submitted voluntarily to the experimental inoculations which resulted in the discovery of the mode of conveyance of yellow fever. The President of the American Medical Association, the Secretary of War, Major General Wood, the Surgeon General of the army and Colonel William C. Gorgas are named as the commission to select the site and supervise the erection of this monument. This effort to perpetuate by worthy national recognition the memory of high courage and beneficent achievement will doubtless receive the endorsement and active interest and support of this association.

Monument to Medical Officers of War

In this connection I may recall to your attention that, in accordance with the recommendation of my immediate predecessor, Dr. Gorgas, in favor of the suggestion of Dr. Weir Mitchell the association has already taken action looking to the erection in the national capital of a monument in memory of the medical officers on both sides who gave up their lives in the performance of their duties during the war between the states. This purpose to commemorate members of our guild whose services in a national crisis were for humanity should appeal strongly to the members of the profession throughout the country.

Theme: Activities of the Association

It is my purpose in this address to call your attention chiefly to certain subjects suggested by some of the activities of this association, with the desire of indicating to some extent and in a general way their nature and what has been accomplished, especially in recent years. Within the limits of an address none of these topics can be treated exhaustively, and many

of equal importance must be left untouched. As the president has the opportunity of offering directly to the House of Delegates whatever specific suggestions he may desire to make, I shall not use this occasion for that purpose.

Development of Scientific Associations

The spirit of association is inherent in human nature. Although voluntary associations of those pursuing the same occupation and having common interests have existed from ancient times, it was not until the Renaissance that literary societies, nor until the rise of experimental science in the seventeenth century that scientific societies in the modern sense were formed. As is well known these early societies, in which medicine was not separated from the natural and physical sciences, were powerful agencies in the advancement and diffusion of knowledge. The eighteenth century saw the development of separate local medical societies, both in Europe and in this country. Before the end of this century not less than seven of our state medical societies had been created, the first being that of New Jersey. The original charter of the Connecticut Medical Society, incorporated in 1792, is historically almost as interesting as the famous Connecticut Constitution of 1639, for it embodied the essential federative feature of the present plan of organization of our state and national associations by constituting the county society as the unit with representation by delegates in the state society.

A new type of scientific society, of national scope and characterized by periodical, migratory meetings, originated in 1822, chiefly through the efforts of von Humboldt, by the formation of the still flourishing *Gesellschaft Deutscher Naturforscher und Aerzte.* The occasion for the formation of this and later of many similar societies is to be sought mainly in the growth and organization of science, with the consequent greater need of intercourse, as well as in improved facilities of travel.

Origin of American Medical Association

It is to this type of itinerant national society with annual meetings that the American Medical Association, started in 1846, belongs, and although sixty-four years is a brief life in the history of institutions, still our association not only is the first example of this pattern of society in this country, but it is one of the oldest kind in the world, being preceded by the German society mentioned, the British Association for the Advancement of Science in 1831 and the British Medical Association in 1832.

Although the origin of the American Medical Association is to be traced to a national convention of delegates from medical societies and colleges,

called by the Medical Society of the State of New York, mainly through the efforts of Nathan Smith Davis, to elevate the standard of medical education, then in a most deplorable condition in this country, it may be recalled that the same society as early as 1839 adopted a resolution offered by Dr. John McCall with the following preamble: "A national medical convention would advance in the apprehension of this society, the cause of the medical profession throughout our land, in thus affording an interchange of views and sentiments on the most interesting of all subjects—that involving men's health and the means of securing or recovering the same." Although the steps then taken to secure this end proved fruitless, it was more in accordance with the broad spirit of Dr. McCall's resolution than with the narrower, though important purpose determining the call of the convention of 1846 in New York that the organization of the American Medical Association was effected at the meeting in Philadelphia in 1847, when the purposes were declared in the preamble to the constitution to be "for cultivating and advancing medical knowledge; for elevating the standard of medical education; for promoting the usefulness, honor and interests of the medical profession; for enlightening and directing public opinion in regard to the duties, responsibilities and requirements of medical men; for exciting and encouraging emulation and concert of action in the profession, and for facilitating and fostering friendly intercourse between those engaged in it."

Our present constitution, adopted in 1901 has not added to nor changed materially these excellent purposes as originally declared, save in one particular, which is significant of the progress of medicine and the relations of physicians to the community. "The broad problems of hygiene" are substituted for the "duties, responsibilities and requirements of medical men" as the subject for enlightenment and direction of public opinion.

Early Organization

At the birth of the association much discussion was given to the question whether it should be organized as a representative body or as a self-constituted and self-perpetuating society, electing its own members. It is curious to think what would have been the history of the association had not the wiser choice been made, in favor of the more democratic, representative plan. This plan which continued in operation for fifty-five years, provided for representation not only from permanently organized medical societies, whether local district or state, but also from medical colleges, hospitals and other institutions, every ten members of an auxiliary society being entitled to a delegate and only the delegates having a voice in the conduct and affairs of the association. However cumbersome and ineffective this basis of repre-

sentation became with the growth of the profession and of the country, it was well suited to the conditions existing at the time of its adoption.

First Half-Century

The association has grown so rapidly and achieved so much since its improved organization nine years ago, that we are in danger of losing sight of the great service which it rendered to the profession during the preceding half-century, in spite of defects and failures and errors. The founders of the American Medical Association brought into being a national organization, truly representative of the whole medical profession of this country. Such an organization has inherent elements of strength which secure its future even against its own blunders and still more against the attacks from without. In spite of an unfortunate incident in its history the association has been from the beginning the great unifying force for the profession of this country, whose common interests it has been its chief endeavor to serve. Since its foundation it has had the devoted loyalty and faithful services of many leaders of the profession.

English and American physicians of the early part of the last century were greatly inspired by the work of the admirable Manchester physician, Dr. Thomas Percival, entitled "Medical Ethics" which appeared in 1803, and many medical societies of that period adopted codes of ethics based upon the precepts of this excellent book. The American Medical Association followed this custom in framing such a code and thereby exerted a distinctive and beneficent influence upon standards of professional conduct throughout this country. Although in the form and certain details this code became obsolete, its underlying principles are enduring.

The central object of the organization, the cultivation of medical science and art, was always kept clearly in view. The condition and the progress of American medicine are well reflected in the thirty-three volumes of our "Transactions," followed by the Journal, established in 1883. My memory goes back to attendance on meetings in the late seventies and I recall attractive programs, inspiring addresses, valuable scientific papers, agreeable personal and social intercourse and generous hospitality.

What the association was able to accomplish in the first fifty years of its existence in regard to such matters of professional and public interest as medical education, legislation, organization, protection from fraud, is insignificant in comparison with the achievements of the last decade, but this failure was not due to lack of effort or of interest or of realization of the conditions. The fault was mainly in the machinery of organization, long recognized as outworn and inadequate, which rendered practically

impossible orderly and effective transaction of business, deliberate and well-considered action, and the adoption and carrying out of any continuous policy or undertaking.

New Era

My object in this brief reference to the past of the association is not to trace details of history, but to indicate, in the first place, that improvement in organization was urgently needed and, secondly, that the improved organization effected nine years ago marked no break with the past, but was in the nature of an orderly evolution along predetermined lines toward larger and better things. The past decade is often spoken of as a new era in the life of the association, and such it is, although only in the sense that it is characterized by the attainment of results long desired and long striven for and by possibilities of ever-increasing usefulness.

Improved Organization

The much needed but very simple change in the form of organization effected in 1901 after full discussion and mature consideration was in its essential features identical with that proposed in 1887 by a committee of which the founder of the association, Dr. Nathan Smith Davis was chairman; and there can scarcely be found a more striking illustration of the defects of the old plan than the long delay in the adoption of this proposal, a delay resulting not from opposition, but from sheer inability to secure proper deliberation and effective action in the business meetings. It is gratifying and worthy of note that both the earlier and the present plans of organization should embody so largely the conceptions of one man, whose great services to the profession and the public as founder of this association and for more than half a century zealous promoter of its welfare, as eminent physician and educator, and as public spirited and far-sighted citizen should stir the members of the association to more active efforts in behalf of the Davis memorial fund, so that the sum of $5000 conditionally appropriated to this purpose by the trustees may be rendered available.

By basing membership and the right of representation in the association on the state associations, by creating a delegated business body, large enough to be truly representative but not so numerous as to be ineffective in the transaction of business, and meeting separately from the general and scientific sessions, and by securing on the part of the state associations the adoption of the county society as the unit of the system, a federative organization of the medical profession of this country has been brought about as simple as it is effective. Whatever may be needed in perfecting

details of this plan of organization, the experience of nearly a decade has demonstrated convincingly the soundness and wisdom of its fundamental features.

Organization however carefully devised by man, is inert until it acquires living force by the efforts of those who set it in motion, and the good accomplished depends far more on the character of these efforts than the instrument employed.

The association in these latter years has been fortunate in enlisting the adhesion and cooperation of many of the best workers in the profession and even in allied fields, who have given unselfishly their time and energy and thought to work in behalf of professional and public interests; but there are two men entrusted with the most important official duties, whose services have been so conspicuous and are so deserving of the gratitude of the profession that it is only just to mention their names in this connection: Dr. George H. Simmons, who, as general secretary and manager and editor of "The Journal," has done more than any one else to determine and further the policies of the association and to place it in its present high position of influence and usefulness; and Dr. Joseph N. McCormack, who, in connection with his valuable work as organizer, has preached the gospel of public health throughout the length and breadth of this land.

Achievements of the Last Decade

Among the more striking beneficial results accomplished by the association during the past decade I may enumerate the unification and effective organization of the profession; the growth of the national and constituent associations in membership and influence; the development of "The Journal" to an importance unsurpassed by any medical weekly in the world; the improvement of the educational and scientific work of the association through its sections, its scientific exhibit, its grants in aid of research, and the public lectures and addresses of Dr. McCormack; the establishment of the Council on Pharmacy and Chemistry with its chemical laboratory, the Council on Medical Education, the Committee on Medical Legislation, the Council on Defense of Medical Research, the Committee on Ophthalmia Neonatorum, the Committee on Nomenclature and Classification of Diseases, the Board of Public Instruction on Medical Subjects, the Women's Committee on Public Health Education (the status of which, however, awaits clearer definition) and other special committees supported by funds of the association and working continuously; the compilation and publication of two editions of an authoritative medical directory, owned by the profession; the foundation and publication, without expense to the associa-

tion, of the "Archives of Internal Medicine," in order to meet an urgent need of higher clinical medicine; and finally, the erection of a new building to accommodate the printing plant and working forces of the association. This is indeed a record of large and beneficent achievement. To describe in any detail the results of the activities here enumerated would far exceed the limits of this address; but on a few of the more significant ones permit me to touch.

Council on Pharmacy and Chemistry

Of the work accomplished by councils and committees that of the Council on Pharmacy and Chemistry is the most notable, and merits the high commendation which it has received from the profession and the enlightened public. A check has at last been put on the exploitation of the profession and to a considerable extent likewise of the public by the strongly entrenched and widely ramifying patent-medicine evil with its shameless frauds, misrepresentations, deceits and dangerous practices. The work of this council has assumed international proportions and it is gratifying to note that ligitimate pharmacy and the respectable manufacturing pharmacists are coming to appreciate more and more its benefits to them.

Medical Education

For the last six years the Council on Medical Education, by steady, continuous, well-directed work, including personal inspection, has been engaged in collecting and publishing a vast amount of accurate, detailed information concerning the medical schools and every phase of medical education in this country. Its conferences have been attended by leading educators, and the addresses and discussions on these occasions have been interesting and valuable. The purpose of all this work has been constructive and not critical. The facts elicited as well as those published in the highly important "Report on Medical Education of the Carnegie Foundation for the Advancement of Teaching," which has just appeared, while confirmatory of general impressions, acquire impressive significance when marshaled in concrete, statistical form and are of enormous consequences to the medical profession and the community. The attitude of physicians should be clear in this matter, for the strength and credit of the profession, the great interests of public health, municipal, state and national, and the welfare of the individual all depend on the quality of training given in our medical schools.

The immediately urgent directions of improvement are reduction in the number of poorly supported, existing medical schools by demise or by

merger, provision of adequate financial support beyond the fees of students, the elevation and, even more, the conscientious enforcement of the requirements for preliminary training and of standards, the maintenance of at least five well-equipped laboratories conducted by teachers giving their whole time to the work, far better clinical training, such as can be given only in a hospital owned by the school or affiliated with it as its teaching hospital, and realization on the part of universities of their responsibilities for their departments of medicine.

The argument that the country needs today, if it ever did, cheap and inferior medical colleges is wholly fallacious, for we have at present in this country practically as many medical schools as all the rest of the world combined, and four to five times as many doctors in ratio to the population as Germany and the older civilized countries; and, moreover, graduates of lowgrade schools manifest no peculiar inclination or tendency to seek remote and unpromising localities, but prefer competition in fields already over-crowded.

There have been in recent years influences in operation tending to a diminution in the number of medical schools and students of medicine. Among these influences may be recognized the inevitable pressure exerted by the demands of the state licensing boards and an awakened sense of loyalty and duty to the profession on the part of some of the weaker schools and of many physicians in consequence of fuller realization of the educational requirements of modern medicine, but, as the phenomenon is worldwide, some deeper causes are operative. There may be larger recourse to certain special healing cults and a growing discrimination on the part of the public between well-trained and ill-trained physicians; but more significant is the lessened demand for the services of physicians resulting from the marked diminution in the amount of disease, especially the acute infections and tuberculosis, as the result of modern sanitation and public health movements, and the increasing tendency of rich and poor alike to seek treatment for medical as well as surgical ailments in hospitals.

Certain of these conditions afford much food for serious thought, as they are of great economic importance to the medical profession, but I cannot pause to discuss them on this occasion, save to remark that new and rewarding opportunities and a new mission of service are opening to properly trained physicians in the great fields of public hygiene and preventive medicine. It is a serious defect of our medical schools in general that they do not at present provide adequate training for work of this character.

The outlook for improvement of medical education in this country is most encouraging. We already have a few excellent medical schools, com-

parable with the best in Europe, and the general average is rapidly advancing, so that we need not despair of attaining conditions of medical education which shall cease to be a reproach to us. The reform of medical education in this country is moving forward by the aid of many agencies and influences, and when its history is written the work of the Council on Medical Education of this association will fill an important chapter.

The city of St. Louis today offers in the reorganization of the medical department of Washington University the finest possible example of improvement in medical education and the way to accomplish it. This medical school aided by splendid gifts of enlightened benefactors and by the affiliation of a group of admirable hospitals and broadly planned with clear recognition of the needs of modern medicine, is destined to be among the foremost in this country and to exert a strong influence on medical education throughout the land, and especially in the middle West and South. I am sure that my colleagues of the American Medical Association desire me to extend, on this occasion and in this place in their behalf, our hearty congratulations and best wishes to Washington University and its medical school and to express to the donors our grateful appreciation of their generous benefactions to the cause of higher medical education and thereby to humanity.

Animal Experimentation

The Council on Defense of Medical Research is performing well a duty which we owe not only to the present generation, but to all who are to follow us, for there would be little hope for the future of medical education or the progress of medical science and art if medicine were deprived of the method of experimentation. This method, which from the nature of the subject matter must consist largely in experimentation on animals in the biological and medical sciences, is for the science of medicine precisely what it is for chemistry and physics, its greater lever of advancement. Observation and experiment are the warp and woof of the fabric of scientific medicine, the one as necessary as the other. Animal experimentation, however, differs from experimentation with inanimate matter in that it should never be undertaken without a serious purpose and a grave sense of responsibility to avoid the infliction of all unnecessary pain; and it is a fact that in no other use of animals for the benefit of man is equal solicitude exercised in this regard.

The antivivisectionists are engaged in an utterly hopeless undertaking in their attempts to convince the public that experimentation on animals is of little or not benefit to mankind. As all physicians know these benefits are simply inestimable, and one is almost inclined to welcome an agitation

which has afforded us the opportunity to present to the public conclusive evidence on this question in the admirable papers already published and in course of preparation under the supervision of the Council on Defense of Medical Research, which is doing a work comparable to that of the British Council on the same subject. These papers, issued in pamphlet form, have been widely circulated and are at the service of any one who desires to use them.

In their charges of wanton cruelty brought against physiologists and physicians, as well as in their efforts to demonstrate the inutility of animal experimentation, the antivivisectionists have long conducted an agitation unmatched for recklessness of statement, slanderous misrepresentation and deceit, unbounded credulity, and ignorance, not through any personal knowledge of the object of their attack or of its relations to the interests of science and humanity. The agitation for the prohibition of experiments on animals, conducted under the guise of an humane purpose, is fundamentally inhuman, for if it were to succeed the best hopes of humanity for further escape from physical suffering and disease would be destroyed.

Those who are familiar with the conditions of animal experimentation as practised in this country and are most competent to judge are convinced that no further legislation relating to the subject is needed. No special legislation regulative of this practice and at all acceptable to those who seek such regulation has ever been proposed which is not open to serious objections as interfering with useful and proper experimentation and subjecting experimenters to unnecessary and intolerable restrictions, supervision and annoyance. The enactment of such legislation in Great Britain has been a stimulus rather than a quietus to continuance of the pernicious agitation and has been detrimental to the interests of medical science and art in that country. Vigilance in guarding against the enactment of legislation of this character in any part of this country is a duty which physicians owe to the science and art which they cultivate and to the welfare of the community.

Medical and Health Legislation

This association as the representative of the medical profession of this nation cannot and should not be indifferent to legislation relating to important matters of public health and medicine, but the determination of the precise character and extent of its activities in this field is a question of considerable difficulty which we have not as yet fully and satisfactorily solved. The association should assuredly keep aloof from politics in the customary significance of this term, and it should never resort to the arts of the politician. It should never appear in advocacy of legislative measures which

are not clearly for the public welfare. Being a national organization, it should not intervene actively in state legislation, although here it may be helpful in an educational and advisory capacity. Its function and indeed its duty in relation to national legislation concerning health and medicine is to utter the voice of medical science as effectively as possible and to endeavor to have it heard by the lawmakers. It was entirely right and proper for this association through its Committee on Medical Legislation to aid in the defeat of the antivivisection bill before Congress ten years ago and to support the passage of the Food and Drugs Act, the pensions for the widows of our medical heroes, Reed, Lazear and Carroll, the introduction of trained nursing in the army, the various public health bills, including the one now under consideration for a department of public health, and indeed, I believe, of every bill which this committee with varying success has advocated in Congress.

When Congress manifests such ignorance and indifference to urgent demands of sanitation as it did in framing the bill constituting the Isthmian Canal Commission, which took the fullest cognizance of the engineering problem and utterly ignored the equally important and not less difficult sanitary problem, the association would have been culpable in not directing attention to the omission and in failing to urge the appointment as a member of the commission of the eminent sanitarian whom I am proud to succeed in this presidential office, and who had already given proof that if any one could conquer the pestilences which had frustrated previous attempts to construct the canal, he was the man. And how well he has justified our faith by achieving the greatest triumph in practical sanitation in history!

The field of usefulness for this association regarding legislation properly within its purview, includes, however, more than the advocacy or disapproval of specific laws already framed; it embraces likewise such matters as the collection of facts, legal opinions, historical data and information bearing on the questions concerned, the careful study of fundamental legal principles and of existing conditions in order to know what is right and also what is practicable, the examination of medical and sanitary laws, administration and activities in this country and abroad with a view to useful recommendations, the discriminating consideration of the powers and functions of the national government and of state and local governments respectively in the protection and promotion of the public health, cooperation with other agencies and efforts, especially those endeavoring to secure greater uniformity in state legislation by framing model laws relating to vital statistics, medical licensure, pure food and drugs, and the like, and the education of the public opinion in support of laws for the common good, which are the only laws in which this association has any interest whatever.

Since the establishment of the Bureau of Medical Legislation at the association headquarters three years ago a good beginning has been made in constructive work of this character. The interesting and exhaustive discussion on a model law for the regulation of the practice of medicine at the joint conference of the Committee on Medical Legislation and the Council on Medical Education held in Chicago last March, while it constituted a most valuable contribution to this intricate and perplexing subject, brought out the lack of agreement on fundamental principles and forcibly exemplified the need of such preliminary work as I have indicated.

Vital Statistics

The framing of a model bill for the registration of vital statistics, combined with the excellent work of the Committee on Nomenclature and Classification of Diseases, should greatly facilitate the extension of the area of registration of births and deaths in this country and improve conditions within a registration area. Vital statistics is the very foundation of sanitary science and of practical sanitation, and its neglect in this country has been as much of a reproach to us as our low standards of medical education. The association and all the physicians of the country should do their best to remove this reproach as rapidly as possible. The intimate connection of accurate registration of births with public health problems may be illustrated by the emphasis justly placed upon it in the admirable reports of the Committee on Ophthalmia Neonatorum. This committee, whose work is a great credit to the association and has become an important factor in the stirring campaign for the prevention of blindness, is brought likewise into close contact with another serious legislative problem, namely the regulation of midwifery practice.

Department of Health

Most gratifying is the awakening of sentiment beyond the confines of the medical profession in favor of the creation of a department of public health in the national government, of which this association in its official action has long been an earnest advocate. It is especially significant that economists, experts in life-insurance, those interested in the industrial and social conditions of the laboring classes and others whose occupations and studies lead them to a realization of the enormous waste of life and energy from preventable diseases have espoused the movement for greater activities of the federal government in the protection of the people's health. The Committee of One Hundred, originating as a committee of the section of social science and economics of the Association for the Advancement of Science, which represents science in this country as our association represents medicine,

has done an important and patriotic service in educating public opinion and stirring up interest in this great cause.

I do not see how any intelligent and patriotic citizen who has studied the question can fail to reach the conclusion that the federal government should do far more than it is doing in the promotion of public health, and that such increased activity, properly directed, would be of incalculable benefit in the saving of human life, health and energy. I agree with the great majority of the members of this association that the best way to secure this result is by the creation of a national department of public health. While it may be that a mature and detailed plan of organization for such a department has not yet been devised, the primary and essential thing is to demonstrate the need, and this, I believe, has been done. The Public Health and Marine-Hospital Service is already a partial bureau of health with an excellent hygienic laboratory, so far as it has been developed. Its incorporation in a department of health would enable it to increase its functions and expand its usefulness. There are many suggestive analogies between the growth, functions and general plan of organization of the Department of Agriculture and the corresponding features of the proposed department of health and the argument for the establishment of the latter is stronger than was that for an agricultural department when this was formed.

Those who have been fighting for years the battles of public health in this country and have been discouraged by the indifference of our national legislators to this subject in its relations to the federal government have been inspired in the last few months by the appearance in the Senate of the United States of a champion of this cause, Senator Owen of Oklahoma, who, with an intelligent grasp of the significance of preventive medicine for the conservation of the human resources of the nation, has vigorously urged the need of further action by Congress in this direction, and has introduced a bill for the creation of a federal department of public health. The principles of this bill—and it is only on the principles and not the details, that Senator Owen himself lays importance—have been endorsed by the Committee on Legislation of the Association, the Committee of One Hundred, and a large number of eminent physicians, sanitarians and others who have interested themselves in the matter.

Sectarian Medicine

The introduction of Senator Owen's bill has been made a pretext for an attack on this association of such a preposterous nature and led by interests of such character that there is no occasion for our concerning ourselves with it. We represent no school of medicine and no system of healing, allopathic,

old, regular or other. We are simply physicians, as chemists are chemists and physicists are physicists, seeking to advance the boundaries of medical knowledge and to base, as far as possible, the practice of our art on scientific principles and sound experience. Our concern with the legal regulation of the practice of medicine differs in no respect from that of the rest of the community and is merely that those who assume to practise the healing art as a profession shall have some adequate knowledge of the human body in health and in disease. While we know, as all men of science must know, that there can be no dogma, principle, system or method universally applicable to the treatment of disease, we are aware that new knowledge may come from the most unpromising sources and we are eager to discover what good there may be in the claims of the advocates of any peculiar system of treatment; and if such is found, there is nothing whatever in our principles to prevent us from adopting it, or, in fact, from employing any method of cure which the physican may deem best. We have no intention or desire to interfere, even if we could, with the freedom of the individual to employ any one or any method of healing he may please, so long as the interests of public health are not endangered thereby. Incredible as it may seem to those whose vision does not extend beyond personal and commercial interests, we are engaged in the campaign for public health from purely altruistic motives, for we hope the day is not far distant when there will be less disease to demand the services of physicians.

The idea that a federal department of health could have anything whatever to do with the regulation of the practice of medicine throughout the country merely betrays abysmal ignorance of the constitutional principles of our government. Of the two great divisions of medicine, it is only with the curative that sectarian medicine has concerned itself, while to the preventive side, where our great conquests lie, it has contributed nothing. It is not surprising that the better representatives of sectarian medicine, realizing the false position in which it has been attempted to place them, should have hastened to disclaim any connection with the grotesque movement organized to defeat the creation of a federal department of health on the ground that it is favored by the great body of physicians of this country represented in this association.

International Congress of Hygiene

Had time permitted I should have been glad to speak of other activities of the association particularly the somewhat scattered ones in the field of public hygiene. Here I shall only remind you that the important International Congress of Hygiene and Demography, which is to meet in this country in 1912 on invitation of the government, will doubtless be of great

interest and should give a powerful impetus to the movement for better sanitary administration throughout the country.

George Washington Memorial Association

The difficulty of housing such a congress in the national capital and our experience in this respect in caring for the International Congress on Tuberculosis in 1908 bring home to us forcibly the importance of aiding the efforts of the George Washington Memorial Association, already endorsed by this association, to provide in the city of Washington a suitable building containing halls, lecture rooms and a large auditorium for the accommodation of national and international congresses.

Need of Economy

My service for six years as a trustee of this association leads me to remind the members that our funds are relatively small in comparison with the fields of usefulness which we would like to cover. This condition necessitates careful consideration by the delegates and trustees of the numerous proposals in order to select those which seem to belong most properly to the sphere of the association and are not adequately provided for by other agencies, and of these to choose the ones which appear to be most important and most urgent and to give promise of the most rewarding results. Experience has shown that the best returns are obtained from systematic, centralized work continuing over a number of years.

Sections and Scientific Exhibit

While I have devoted the larger part of this address to the consideration of certain subjects of wide professional and public interest which have properly engaged the attention of the association in its capacity of national representation of the great body of physicians of this country, it should never be forgotten that the main purpose of this organization is that which is placed first in our constitution—the promotion of the science and art of medicine. All of the activities should center around this purpose and be contributory to it. These central educational and scientific functions are most effectively served by "The Journal" and by meetings of the various sections at the annual sessions. It is these more than aught else which interest the members of the association and which hold the organization together. Their development and success should always be the first thought and highest endeavor of this association.

The scientific exhibit, under the energetic, self-sacrificing direction of Dr. Wynn, to whom the association owes a large debt of gratitude has grown

into one of the most useful, attractive and instructive features of our meetings, with promise of even wider and more varied scientific and educational value. It has already gained a position which, to say the least, is coordinate in interest and importance to a section, and it should receive every possible encouragement and support from the association.

Organized Effort

Organized effort is a distinguishing mark of modern civilization. It is as essential for the advancement of science, of education, of social and industrial reform, of philanthropic endeavor, as for the promotion of commerce. With the remarkable progress of medical science, especially during the last three decades, man's power to control disease has been vastly increased, and the sphere of usefulness of the physician has been correspondingly widened, and with advancing knowledge will continue to expand. The skill and knowledge of the physician and sanitarian have acquired a new and ever increasing importance and significance in the movements for social amelioration, for improvement of the conditions of labor and of living, for the conservation and most efficient utilization of the productive energy of the world, and for the reclamation of regions now yielding no return to civilization.

Among the organized forces for advancing the prosperity, the happiness and the well being of the people of this country, the American Medical Association has an important part to play. We are justified in the confidence that, with the united support and loyalty of the profession, this association, broadly representative and standing for the best ideals of medical science and art and for professional and civic righteousness, will contribute a beneficent share to the working out of our national destiny.

IN ACCEPTANCE OF A VOLUME OF CONTRIBUTIONS TO MEDICAL SCIENCE[1]

I have no words adequate to express my appreciation of this demonstration of your affection and loyalty. With a heart full of thanks I accept this magnificent volume of contributions to medical science by my pupils and coworkers, now and in the past.

I thank you, Dr. Councilman, for your generous words in presenting this volume, even if I must believe that your estimate has far exceeded my merits. Although I have been kept in ignorance of the details of this undertaking, I know that my especial thanks are due to Dr. Mall and Dr. Flexner for its inception and conduct, as well as for the incentive to several of the contributions. Turning the pages I see how much is due to the marvelous artistic skill of Mr. Broedel, and I am not surprised to hear of the unselfish devotion of Dr. Hurd in the editorial work, nor that my old friend and colleague, Dr. Halsted, has been active in arranging for this occasion. To all who have honored me by their contributions to this volume I am deeply grateful, and the kind messages from many other pupils and associates have gladdened me.

Nothing could afford me livelier pleasure and satisfaction than to have my name thus associated with a volume of contributions, which cannot fail to interest all workers in scientific medicine. I recognize among the contributors not only the names of those who have gained distinction as investigators, but also of those who are beginning their careers and will now win their first spurs. To me the most significant feature of this occasion is that the time has come in America when a group of investigators, more or less closely connected through common teachers, can bring together so large a number of important, original contributions to medical science. Twenty-five years ago this would not have been possible. That I should have been permitted to participate with others in bringing about this advance is to me a source of much gratification.

When Dr. Prudden and I first started our small laboratories in New York, he at the College of Physicians and Surgeons, and I at the Bellevue Hospital Medical College, the outlook was not encouraging for a young

[1] Report of remarks made in acceptance of a volume of contributions to medical science, upon the occasion of the Twenty-fifth Anniversary of his Graduation, at a dinner at the Maryland Club, Baltimore, May 4, 1900.

Johns Hopkins Hosp. Bull., Balt., 1900, XI, 136-137.

man to select pathology as a career. The contrast between then and now in this respect is indeed striking. Today, pathology is everywhere recognized as a subject of fundamental importance in medical education, and is represented in our best medical schools by a full professorship. At least a dozen good pathological laboratories, equipped not only for teaching, but also for research, have been founded; many of our best hospitals have established clinical and pathological laboratories; fellowships and assistantships afford opportunity for the thorough training and advancement of those who wish to follow pathology as their career; special workers with suitable preliminary education are attracted to undertake original studies in our pathological laboratories; students are beginning to realize the benefits of a year or more spent in pathological work after their graduation; and as a result of all these activities the contributions to pathology from our American laboratories take rank with those from the best European ones. While we realize that we are only at the beginning of better things, and that far more remains to be accomplished than has yet been attained, nevertheless the progress of pathology in America during these twenty-five years has surely been most encouraging. When I look back over this quarter of a century I realize how favored I have been by my opportunities, and here you will permit me to be somewhat personal.

My interest in pathological anatomy was awakened in my student and hospital days by Delafield and Janeway, who are among the best pathological anatomists whom I have ever known. I received also a strong stimulus toward scientific work from Jacobi, the seventieth anniversary of whose birthday will be celebrated tomorrow night in New York by well-earned honors. I owe more than I can tell you to my teachers in Germany, to Cohnheim, Weigert, von Recklinghausen, and Wagner, and through them to the great master, Rudolph Virchow. Upon my return to this country my association with Dr. Austin Flint, the elder, was to me an inspiration, and in many ways of the greatest advantage.

While the prospects for earning a livelihood and for advancement in the career of a pathologist may not have seemed encouraging in New York twenty-two years ago, in reality the circumstances were fortunate. About that time there were introduced great improvements in histological technique, which led to a deeper insight into the structure and activities of cells and opened the way for new directions of development. Above all, it was the beginning of the bacteriological era marked by the great discoveries of Koch, of whose earliest work I saw something while studying in Cohnheim's laboratory in Breslau, and whose personal teaching I later enjoyed. To have begun one's work as a teacher of pathology at such a period, and after intercourse with such masters of the science, and

to have been permitted to continue it during these years of unparalleled progress, must be considered a circumstance fortunate for the teacher. The time was fully ripe in this country for the introduction of laboratory teaching and investigation in pathology, and it is certain that if one had not appeared to undertake it another would have done so. It was an easy matter under such circumstances to demonstrate the value of the pathological laboratory in medical education. I have every reason to feel grateful for the encouragement and support accorded the little laboratory at Bellevue and the opportunities there afforded to me. Prudden's laboratory, founded about the same time at the College of Physicians and Surgeons, has developed under his masterly direction into a large and splendidly equipped laboratory, surpassed by none in its influence upon the advancement of pathology in this country.

I need not speak here of the wider opportunities, so well known to you, which I found in Baltimore; of the liberal policy of the trustees of The Johns Hopkins University and Hospital in the establishment and support of the pathological laboratory; of the advantages derived from the intimate association of the medical school with this great university and hospital; of the stimulus received from my colleagues, and of the attraction of our high standards of education in drawing to us highly trained students. Above all I have been most fortunate in those who have worked with me as pupils and associates, and to these coworkers is due in the first instance whatever of success has attended my efforts as a teacher and student of pathology. I am delighted to see here tonight my old friend and coworker in the New York laboratory, Dr. Meltzer, and also Dr. Beyer. To have had such a coadjutor in the early organization and conduct of the Baltimore laboratory as Councilman, such an original investigator as Mall for the first fellow in pathology, such special workers in the early days of the laboratory as Sternberg, Halsted, Herter, Abbott, Bolton, Nuttall, Booker, Miller, Berkley, Clement, Howard, Russell, Blachstein, Thomas, Williams, Randolph, Gilchrist, and others, all of this I count as the best of good fortune.

I call to mind on this occasion with affectionate regard many others who have followed these earlier workers, but the list is too long to enumerate. I must, however, give expression of my indebtedness to Flexner, who since the opening of the medical school until the end of the last academic year has been my closest associate in the work of teaching and in the supervision of the laboratory. While it has been hard to part with such associates, it is a matter of pardonable pride that so many have been called to important chairs in other institutions—Councilman to Harvard, Abbot, Flexner and Clark to the University of Pennsylvania, Wright to

the laboratory of the Massachusetts General Hospital, H. U. Williams to the University of Buffalo, Blumer to the Bender Hygienic Laboratory in Albany, Bolton to the Hoagland Laboratory and subsequently to other institutions, Howard to the Western Reserve University, Nuttall to the University of Cambridge, England, Russell to the University of Wisconsin, and now we are to lose Barker, most scholarly, versatile and inspiring of teachers, and profound in his studies, who has been called to an important position in the University of Chicago. That we shall retain with us young men of great promise is evidenced by such contributions as those of Cullen, Cushing, Young, Bardeen, the MacCallums and Opie in this memorial volume. I rejoice to see in this book in connection with Cushing's the name of our much-loved Livingood, whose career of unusual promise was cut short by an ill-timed fate.

I should like to be able to speak of the value of the contents of this volume which you have dedicated to me, but I see it tonight for the first time. A glance through the pages assures me that here are gathered together papers with which any medical teacher in the world would be proud to have his name associated. I may be permitted to call attention to the importance of the contributions from our women students, and it will not, I trust, be invidious if I mention the superb work of Miss Florence Sabin, done under Mall's and Barker's direction, and so beautifully illustrated by Mr. Broedel. As I have already said, I see in this volume of studies an index of the great advance during the last quarter of a century in the material conditions surrounding pathological teaching and investigation in this country, brought about especially through the establishment of laboratories. It is also a significant token of the greater things which we may assuredly expect in the future, when America will take her place in the front rank with those countries which contribute most to the progress of the medical and biological sciences. If my name shall ever be mentioned among those who in the earlier days have helped to promote our science in this country I shall owe it above all to you, my pupils, colleagues, and fellow-workers.

EXPERIENCE AS A SITTER FOR THE SARGENT PORTRAIT[1]

When, on Saturday night, January 19, I heard Dr. Welch describe his meetings with John Sargent and his experience as a sitter, I was struck by the value of his remarks to the student of art. Speaking as a critic, I think that they gave precisely the little personal touches to the subject which might help some future historian to throw light on the manner in which a great portrait had been made; and as Dr. Welch's words were not, to my knowledge, recorded, I wish to give here at least a summary of them.

His sketch of Sargent's personality was wonderfully true and vivid. He spoke of the painter as a tall, strong, altogether virile type; very agreeable to meet; a widely cultivated man, able to talk well on any subject that might be brought up. For example, Dr. Welch pointed out that the book he is supposed to be reading in the portrait is a seventeenth century edition of Petrarch. He had alluded to a line in the writings of the poet, whereupon Sargent had brought out the volume, and had proceeded to talk in the most interesting manner about Petrarch and the Renaissance in general. Dr. Welch had more than once endeavored to draw Sargent out on the subject of art, and always with suggestive results. Hals and Velasquez were evidently the painter's most cherished masters. He talked so inspiringly about Hals, when Dr. Welch told him he had been looking at "The Laughing Cavalier" in the Wallace Collection, that, as soon as the doctor was free to do so, that summer, he travelled to Haarlem to see the Dutch painter's great corporation groups there. He recalled a saying of Sargent's about Gainsborough—that having painted a thing he left it finished or unfinished, for good or ill, and did not try coldly to work it over and make it academically satisfactory after the fashion of Reynolds. It was impossible to listen to Dr. Welch without being made to realize the genuineness and attractiveness of Sargent's character and personality.

Speaking of the making of the portrait, Dr. Welch described Sargent as grouping his four sitters, over and over again, before he was satisfied. Some times he requested two of the doctors to stand, and then only one of them. He changed their positions, again and again. Before he began to paint, however, he settled upon the grouping that is shown in the completed por-

[1] Report of remarks made upon the occasion of the formal presentation by Mary Garrett of the Sargent's painting of the Four Doctors to the Trustees of The Johns Hopkins University, McCoy Hall, Baltimore, January 19, 1907. This summary of remarks was furnished by Mr. Royal Cortissoz.

Johns Hopkins Univ. Circ., Balt., 1907, XXVI, 19-22.

trait, and this, as Dr. Welch said, disposes of the assertion made by some critics that the composition had taken its form by accident and as the work proceeded. Dr. Welch also noted that the enlargement of the canvas by a piece joined at the side and another at the top was not unforeseen, but was mentioned by Sargent at the outset as a thing he expected to have done. The grouping, then, and the scale of the portrait were fixed by the artist when he began, and so the sitters went on to do their part. They were sometimes all together in the studio, but not often. Sometimes three of them sat, sometimes two of them, but more often each doctor was posed by himself. Dr. Welch's head was painted practically in one sitting. He was struck by Sargent's unobtrusive way of studying him; he never felt that he was being closely scrutinized. Sargent talked constantly while he was at work, smoked innumerable cigarettes, and was always walking to and fro. When Dr. Welch asked him about this exercise, he said laughingly that he had once estimated that he walked about four miles a day in his studio. Though Dr. Welch's head was painted so quickly, the painter was not equally swift in his treatment of all the other sitters. Dr. Osler, especially, had to give sitting after sitting.

The work went forward, on the whole, with great smoothness. There were some difficulties, as when the portrait of Dr. Osler struck them all as a failure and Sargent painted it out and did it all over again. But then everything seemed to move swimmingly. Just at this time Sargent himself suddenly grew discouraged. He paused one day, and knitting his brow, and lifting his hand with a gesture of bewilderment, he said: "It won't do. It isn't a picture. I cannot see just what to do, but it isn't a picture." He stood for a little while thinking it over, and presently the clouds seemed to pass. He asked if there would be anything incongruous about the introduction of a large, old Venetian globe into the background. It was in his other studio, he said, and he would have it brought around if it were permissible. Of course it was; and a day or two after, the globe was there. It was so large that he had to have the doorway chopped to get it into the room. (That was very like Sargent; he would have had an entire wall removed if it had been necessary in making the portrait a perfect work of art.) When they sat again with the globe in the background, Sargent studied the group with anxious interest, and then, in a swift stroke, drew the silhouette of the thing on the canvas. "We have got our picture," he said, and the portrait as it stands shows with what unerring instinct he had thought of the one thing fitted to serve his purpose.

Dr. Welch had some very interesting things to say about the color scheme. He asked Sargent if he could wear his Yale robe, and the painter immedi-

ately acquiesced; but when Dr. Osler spoke of wearing his red Oxford robe, Sargent humorously forbade it, saying:

"No, I can't paint you in that. It won't do. I know all about that red. You know they gave me a degree down there, and I've got one of those robes." Musingly, he went on. "I've left it on the roof in the rain. I've buried it in the garden. It's no use. The red is as red as ever. The stuff is too good. It won't fade. Now, if you could get a Dublin degree? The red robes there are made of different stuff, and if you wash them they come down to a beautiful pink. Do you think you could get a Dublin degree?—No, I couldn't paint you in that Oxford red! Why, do you know they say that the women who work on the red coats worn by the British soldiers have all sorts of trouble with their eyes, etc., etc."

DEDICATION OF OSLER HALL[1]

I shall win your favor at once by stating that I foresaw what I fear those who arranged the program did not, or at least did not indicate in the announcement that I was to give an address, that it was absolutely impossible that there should be an address at the end of these proceedings; indeed, who would be so bold as to attempt an address after hearing such a one from our great master and beloved brother, Dr. Mitchell.

It is at least fitting that a few words should be said to indicate one important feature of these dedicatory exercises, that which is expressed in the name joined to this hall. This is not the occasion, and I know it would be most embarrassing to Dr. Osler if utilized for this purpose, to attempt to estimate in detail what his influence and service have signified to the medical profession of this city and country. I know of no other use for the "Testimonial Fund," which is such a joy to all who contributed to it, that would have been more gratifying to Dr. Osler himself than the use to which it has been practically applied—that it should be merged with the general fund raised for the construction of this fine home for the Medical and Chirurgical Faculty; a place where he himself always felt at home, where he made all who came feel the same way; the place in which his interest has never ceased and continues to abide.

In every sense it is fitting that his name should be recognized in this way, but the actual sum of money, considerable as it is, that has been raised for the construction of the building does not begin to express the debt that the faculty owes to him for the share he has had in bringing about conditions which made possible the erection of this building, and I may even say which rendered necessary the construction of such a home for the faculty. It was really his influence upon the whole profession, and especially upon the younger generation, which brought about such an advancement of standards, such ideals of attainment in the city and state, such achievements and especially such zeal for work in the interest of the faculty; it was these conditions, really, that made possible and necessary the erection of this attractive home for the faculty. I need not attempt to describe in how many ways he has shown interest and expended his time

[1] Report of remarks made at the dedication of Osler Hall, before the Medical and Chirurgical Faculty of the state of Maryland, Baltimore, May 13, 1909.
Bull. Med. & Chir. Fac. Maryland, Balt., 1908-9, I, 241-242.

and energies for the benefit of the faculty. Only those who have lived in the city or state during the fifteen years of Dr. Osler's residence and professional work here can fully appreciate what he has meant to the members of the faculty.

It has been, Dr. Osler, a joy beyond expression to contribute to this fund, a joy beyond expression for the members of this faculty to have the opportunity to indicate in some way, inadequately as it may be, their love and affection for you as a man.

It has been said by our president that this is the most memorable day in the history of the faculty. It it the most enjoyable day in the 110 years of the faculty's life. Dr. Tyson has shown unusual interest in and knowledge of our history, and I want to refer to one striking remark he made —that the Medical and Chirurgical Faculty is unique in its organization; it reaches the whole mass of the profession; it fulfills not only the function of an examining and licensing board and an organization of the forces of the medical profession but combines with many other features a remarkably valuable library. This has not been an organization so select in its membership as to have excluded even a Jenner from its roll. Dr. Mitchell referred to the "Dr. Average." This man is the one benefited above all others by the faculty. It was the average doctor that was reached by Dr. Osler and who has been inspired to that love of books, and it is the average doctor in this state who can fully appreciate what Dr. Mitchell has told us today.

It is a joyful day then for the faculty because for the first time it has a home worthy of its high aims, so substantial that it must in the future be the recipient of gifts, for indeed to him that has, more shall be given, and the Faculty is now a safe custodian for such gifts. From this time on we shall approach nearer and nearer a realization of our ideals. We shall be of greater service to the members of our profession and this faculty will enter into closer relations with the general public. It is then most appropriate that the one who has represented these ideals to us should have his name perpetuated in this, Osler Hall, the central feature of this beautiful building.

IN ACCEPTANCE OF A MEDALLION[1]

Colleagues and Friends—All.—Dr. Thayer has very truly described what led to this occasion. He asked me to reserve April the second for a dinner of a few friends. I little knew then what was in store for me, and if Dr. Thayer knew, he assumed a very discreet air of innocence. "A few friends," he said, "and perhaps a few informal remarks." I have been a little bit shaken in my confiding trust in Dr. Thayer by some alarming paragraphs in the newspapers of late and by some letters which I have received, but I confess that I was quite unprepared for such a gathering as this—for such an overwhelming demonstration of your regard and affection.

You honor me by your presence here in such large numbers and by all that you have done, far beyond any words of appreciation. Indeed I have no words in which to express the sentiments of affection and of gratitude which I entertain. I can say no more than this—that I thank you with all my heart. I can say only that I shall always cherish this occasion in bright and happy memory.

This valuable gift of the medallion is a form of testimonial than which none could be more highly appreciated. It is a possession which I shall hold dear, not only for its intrinsic worth and its artistic merit, but especially as a token of your esteem, of your confidence and your affection. I am especially gratified that the two large copies are to come into the possession of The Johns Hopkins University and of the Medical and Chirurgical Faculty of Maryland, two institutions with which I have been closely identified. I venture to say that Mr. Brenner never gave a more striking demonstration of his skill as an artist than in overcoming the great difficulties of his subject in order to produce such an artistic work; and I wish here to thank Mr. Brenner for all of his interest and pains.

It is not in my power to respond fittingly to all of the expressions of regard which have been uttered here tonight, or to the letters and messages which have been read. I could not trust my feelings even if I attempted to do so. I might reply to Councilman, perhaps, but I could not undertake to give an adequate response to all that has been said. Is it not honor enough for a lifetime to be celebrated in verse by Weir Mitchell? And I wish to tell him how much I appreciate his coming here tonight and honoring me. He is the one who has won the greatest distinction for American medicine. He is the one whom we honor and love as the leader of our profession and our friend.

[1] Report of remarks made extemporaneously at a dinner given in his honor, Baltimore, April 2, 1910.

In: In Honour of William H. Welch. Baltimore, 1910, 40-46.

I ought to have learned from Dr. Jacobi how to behave on such an occasion as this, as he has been the recipient of I know not how many testimonial dinners. I have sometimes marvelled how the praises fell from his shoulders. I rejoice indeed that my old master has honored me by coming here.

You have spoken in all too generous terms of the services which I have rendered to medicine, but I wish to speak here of the debt that I owe to the profession. All that I am today and all that I have ever been able to do has been in consequence of the opportunities which have been presented to me, and I should like, even at the risk of being too personal—though this is, after all, a personal occasion—I should like to mention a few debts that I owe to the medical profession.

Much is said today, and justly, of the defects of the old system of medical education, but I cherish very fond memories of the old College of Physicians and Surgeons. The teachers then inspired us as teachers do today. They presented to us the best ideas of our profession, and we carried away a spirit of zeal and enthusiasm just as students do today. I am glad that, seated at my right hand, is the one to whom I owe my first introduction to and first interest in pathology. Dr. Delafield little knew, when he used to give that summer course in pathological anatomy in the College of Physicians and Surgeons, of the interest which he stimulated in me at that time. When he came to know me better he honored me—and I felt then that it was the greatest honor that could come to me when he gave me the privilege, in his absence, to make an autopsy at Bellevue Hospital and permitted me to record the protocol in his own private autopsy book. He little knew the seed he was sowing then, for this certainly was the very beginning of my interest in pathological anatomy. I owe much to him for the inspiration he gave me.

When I came to Bellevue as an interne I first got to know Abraham Jacobi and he was the one who first directed my attention especially to the great position of German medical science in the world. He used to invite me occasionally to come to his own house, where we would talk over the cases that had interested us in the hospital. It is a great delight to me that this friendship has continued from that time to this. It was an inspiration to me then as it is today.

Another who also influenced me greatly was Edward Janeway. Delafield and Edward Janeway were then chiefly concerned in the cultivation of pathological anatomy in New York and to both of them I feel most grateful.

Leaving the hospital I went to Germany where I spent altogether about three years. From my German masters, Waldeyer, von Recklinghausen and Weigert, and especially from Cohnheim, and later from Ludwig and Robert Koch, I received a stimulus to the pursuit of knowledge which has been my chief possession. I gained from them that kind of information which I believe this country then most needed and which enabled me, I think, to settle in New York.

That period in New York is one which I delight to recall. Dr. Alexander has intimated something of the character of the little laboratory which was offered to me at Bellevue Hospital Medical College. *It was in the beginning of pathological anatomy in this country.* The seeds had been sown in New York and had been developed by Dr. Fitz in Boston, but it was first possible at Bellevue to appreciate pathological anatomy as an important subject in the medical curriculum. Those with whom I was associated there, such men as Dennis, my dear friend, Edward Janeway, and above all Austin Flint—were men from whom I received great assistance. I have never forgotten the names of that first class of young men who came to me in New York—Alexander, Hermann M. Biggs, and Morton Grinnell. I still have a case of post mortem instruments presented to me by that class. And then the men who came later and who have done such good work—Walter James, John Thacher, George Tuttle and others who were with me in those days. I am glad to see many of them here tonight. I owe a great debt to the profession in New York and I am indeed happy that so many New York men have thought it worth while to make a pilgrimage to Baltimore on this occasion.

My coming to Baltimore was simply in the belief that a larger opening was offered. As Dr. Billings, my dear friend, has intimated, I think that he was largely responsible for my coming, and to him in the early days here and to President Gilman I feel most grateful. Those days have been pictured a little by Councilman. He was not trained by me. He was a trained pathologist when I came and was my associate in the work. We had an interesting little group of men—Mall with his remarkable ideas as to the real field of bacteriology (that it was simply for the purpose of learning something about normal tissues), Councilman, Abbott, Nuttall, and Halsted who was then associated in the work in the laboratory. I look back upon those days with the greatest pleasure.

One of the chief enjoyments of my life has been the teaching of and association with young men, and the desire to help them, and there has been no gratification so great to me as to follow the careers of such men and to be conscious that I may have been of some help to them.

I have been especially fortunate in the assistants whom I have had in the laboratory, beginning with Councilman, then followed by Flexner, Abbott, Nuttall, Bolton, Barker, and MacCallum. This association has been to me an unforgettable pleasure.

I was received by the profession in Baltimore with a cordiality which I can never forget. I was made one of them from the beginning and I considered myself entirely identified with the profession of this city. I feel most grateful to all of them and to my friends, not only in the law, but in the general public of Baltimore, who made me feel at home here from the very outset. I have been fortunate, I think, to have been able to partici-

pate somewhat in the civic life of the city and of the state. This is a debt the physician owes to the community in which he lives. If he can do anything to advance public welfare, and especially public health, it is incumbent upon him to do so.

I have received much from the profession of the country at large, much more indeed than I have ever been able to repay. I did not seek the honor of the presidency of the American Medical Association, but I am grateful for it and feel the deepest interest in the welfare of that great national organization which is the representative of the entire profession of this country.

I regret in a measure that I have been drawn so much into outside work, yet at the same time, it has been a very great privilege to participate in the development of the institutions, especially so of the Rockefeller Institute. There is one who has been associated with me there, who has done the same sort of work that I have attempted to do—my dear friend, Dr. Prudden, whom I am delighted to see here tonight. We are contemporaries and started almost at the same time in New York; he at the College of Physicians and Surgeons and I at Bellevue. He has accomplished a great work in New York. In the development of the Rockefeller Institute he has been conspicuous as the director who has given the largest amount of time and thought to the work.

I cannot but regret a certain amount of dissipation of energy which comes from undertaking so many things. My experience ought to be a warning to younger men. I have been more or less driven into it—resisting sometimes—yet at the same time pleasures and privileges have been placed upon me. But I do think that younger men should guard against taking up so many different things as I have undertaken. It reminds me of the story of the little boy who was found crying. A kind gentleman asked him what he was crying about and he said: "Nothing happens at our house unless I get blamed for it, and I never do nothin' neither." I feel as though that was in some sort my fate.

Now, there have been in these thirty-five years great advances in American medicine. They are, I think, chiefly in three fields. First, there has been great progress in the development of medical science, and especially in laboratories. Many have been concerned in this development. I have had only a share with many others, but it has been an immense gratification to see such progress in the opportunities for the cultivation of medical science. And I believe that the recognition that has been won for American science on the other side of the water has been one of the most important developments of the last century.

The improvement in medical education is the second great characteristic of modern medicine. We had in Baltimore a great opportunity. We were

not hampered by tradition and The Johns Hopkins University was, I think, enabled to introduce methods of medical education which constitute a distinct contribution to the subject. It is most satisfactory that what was inaugurated here is being carried on elsewhere, and I think we are only at the very beginning of the progress which may be anticipated in this direction. I cannot claim anything more than having been first on the ground here and having had something to say in the choice of my colleagues. It has been my colleagues as much as myself who have been concerned in the development of medical education in this university.

The third great element of progress has been the organization of the medical profession. That has brought about an elevation of professional standards and has enabled the profession as a united body to accomplish great work in the cure and prevention of disease. I consider the outlook now to be most encouraging. We have come into the possession of new knowledge, but the stores of knowledge which are to come will far surpass all that we now possess. The work of the physician is to be in many respects different and more important. It will be more beneficial than it has been in the past. The work of the physician will be in many ways, I believe, far more attractive than it has been in the past.

What are the attractions of a career in life? They lie, do they not, in the opportunities the career offers for service to mankind, in the congeniality of the work and in its rewards. The profession of medicine surpasses all others in its opportunities for service to our fellow men. Besides this there are manifold fields of activity, appealing to the most varied personal inclinations and aptitudes, be these practical or scientific. The rewards of success in medicine, even of the highest success, lie not in money; they lie in the intellectual pleasure which one gets from his work as a physician, in the consciousness of service in the relief of suffering, and in the cure and prevention of disease. Or it may be that one may attain to the highest satisfaction of all—some contribution to useful knowledge that may be for the healing of the nation. The reward to be most truly prized is the expression of the esteem and of the confidence of one's contemporaries in the profession. So many of the greatest geniuses of our profession have lacked this recognition.

This most highly prized reward has come to me through your kind recognition, even though it be all too generous. It has come to me tonight in the very fullest measure, and in a form both inspiring and never to be forgotten. It has touched my heart with the most profound sentiments of gratitude, which I trust will animate me with a stronger desire to make some return in a closer devotion to high ideals of service and of efficiency in such work as may remain for me to do.

RUDOLF VIRCHOW, PATHOLOGIST[1]

It is fitting that of Virchow's manifold activities that side which represents nearly fifty years of academic work should be a special theme upon this occasion. My contribution, therefore, will relate only to Virchow, the pathologist, the broad view of his career and work in other departments having already been presented to you.

It is as an investigator and teacher of pathology that Virchow ranks as one of the great reformers in medicine.

To appreciate the character and extent of an advance made by scientific discovery, it is necessary to know something about the ideas which have been displaced or overthrown by the discovery. The younger generation of students are in danger of forgetting that facts which are taught to them and which seem to them the simplest and most natural, may have cost years of patient investigation and hard controversy, and possibly have taken the place of doctrines, very different or even contradictory, which long held sway, and which seemed to other generations equally simple and natural. If then, we wish to understand the nature and extent of the reforms in pathology, which we owe to Virchow, we must consider the condition in which he found medicine, and more particularly pathology, in the fourth decade of this century, when he began his scientific work.

At that period medicine in one country was much less influenced by its condition in other countries than is the case at the present time. Medical journals and other means of interchange of ideas were fewer then than now. Medicine was more distinctly national, less cosmopolitan, than it is today.

France unquestionably held the leading position in medicine during the early part of this century. The first three decades mark the most splendid period of French medicine. At the very beginning of the century Bichat laid the foundations of general anatomy by his studies of the tissues. He opened the way for the study and classification of morbid changes according to the tissues affected. This is in some respects the most important contribution to pathological anatomy from the time of Morgagni to that of Virchow. Morgagni showed that the purpose of pathological anatomy is

[1] An address delivered at a meeting to celebrate the Seventieth Anniversary of the birth of Professor Virchow, The Johns Hopkins University, Baltimore, October 13, 1891.

Johns Hopkins Univ. Circ., Balt., 1891, XI, 19-22.

not simply the collection of curious and interesting cases, but is to teach us the seats of disease as is indicated by the title of his great work, "De Sedibus et Causis Morborum per Anatomen Indagatis." He, however, was not able to trace the seats of disease further than to the organs affected. Bichat took a long step forward when he substituted the tissues composing the organs, as the seats of morbid changes, and in this particular direction no distinct advance in pathological anatomy was made for fifty years, when Virchow taught us to go still further back than the tissues, to seek in the cells the seat of disease.

But so far as the gross appearances of diseased organs and tissues are concerned, pathological anatomy was most enthusiastically cultivated in France, and this, together with the development of the methods of physical diagnosis by percussion and auscultation, was made the basis of a new clinical medicine by such men as Corvisart, Laennec, Bayle, Piorry, Louis, Andral. The sound and healthy traditions of this French clinical medicine of the first third of the century, have been continued to the present day, and were early brought to our own country by distinguished pupils of Louis and Trousseau. But the studies in pathological anatomy were fruitful only in certain directions, mainly in diseases of the heart and lungs, and in the elucidation of typhoid fever. They were pursued by clinicians chiefly as a basis of clinical diagnosis. False and exaggerated ideas as to the kind of knowledge to be derived from pathological anatomy led to the establishment of unfounded systems of medical doctrine, such as that of Broussais, regarding irritation and gastro-enteritis, so fatal in its practical consequences. The use of the microscope was even decried by some of the leading pathological anatomists, and when employed led to little of any value. Pathological histology did not exist. Experimental physiology was developed, one can almost say, was originated, by Magendie, but the importance of experiment and clinical observation for the development of pathological physiology, was not generally recognized.

In Great Britain there existed the fructifying influence of the name and teachings of that great investigator in pathology, John Hunter. In some respects Virchow is to be regarded as the immediate successor of John Hunter in the history of pathology, although his work began fifty years after Hunter's death. Both men discarded philosophical speculation and went back to nature, to observation, to experiment for facts on which to build their doctrines. Both made use of all allied sciences at their disposal, of anatomy in the broadest sense, of physiology, in their investigations, but of course much more was available for the later investigator. Both kept constantly in view the problems of practical medicine, together with the broadest interests and direct participation in science. Both recognized

pathological physiology as the foundation of scientific medicine and that this is to be constructed not from anatomical investigations alone, but with the aid of physiology, of experiment and of clinical observation. Hunter was the first to give a broad scientific basis to surgery. Virchow took up many problems just where Hunter had left them. The time had come when he could build deeper and stronger and broader on the foundations of scientific medicine.

In the year of John Hunter's death, his nephew, Matthew Baillie, published his work on "Morbid Anatomy," which is the first one based upon independent systematic observations. The plain, purely objective descriptions, free from the prevailing tendency towards unwarranted generalizations, have given a permanent value to this work. Sound observations continued to be made by such men as Abernethy, the Bells, Abercrombie, Cooper, Howship, Monro, Addison, Gulliver, Bright, Hope, Carswell, but much as they enriched the storehouse of pathological anatomy, the fundamental principles of pathology remained the same, although commendably free from many of the speculative tendencies of the continent.

It was in the third and fourth decades that the great Vienna school of pathology came to the front under Rokitansky and Skoda. As a purely descriptive pathological anatomist, Rokitansky is the greatest who ever lived. The General Hospital of Vienna afforded him an enormous material for observation. When he retired from his professorship at the age of seventy years, he is said to have possessed over 100,000 protocols of autopsies made by himself or his assistants. The industry, acuteness of observation and purposeful character of his work are marvellous. His descriptions of the gross appearances of diseased conditions serve now and will probably continue to serve for a long time as models of clearness, accuracy, conciseness and vividness. As Virchow has said, he is for pathology what Linnaeus is for botany. But in the interpretation of the morbid changes which he decribed so objectively and in the deduction of general pathological principles, Rokitansky was singularly unfortunate. His attempt to construct out of pathological anatomy a general pathology or pathological physiology, is a lamentable failure in the first edition of his great work on pathological anatomy. Bound in the trammels of humoral pathology, he elaborated his doctrine of crases which was at first received so enthusiastically by his followers. It is fair to say that no one was more open to conviction by facts than Rokitansky, and that he threw overboard his whole complicated system of crases after the destructive criticism which it received from Virchow. It was mainly by the teachings of Rokitansky and of his pupils, the great clinician, Skoda, that the nihilistic school of therapeutics developed and dominated for so many years the Vienna school of medicine. With their

attention fixed continually upon the postmortem table and the gross anatomical changes produced by disease, these observers could not comprehend how such changes are amenable to treatment, and they fell into the error of those who make pathological anatomy the exclusive basis of clinical medicine. Those who do this forget that the changes found in the dead organ give only partial, although valuable, information as to the process of disease in the living organ, as to remote effects upon other parts of the body, as to causes of disease, as to disturbances of function.

In Germany proper, medicine presented in the early part of this century a less edifying spectacle than in the other countries mentioned. Although in this period work of fundamental importance was done in allied sciences, such as comparative anatomy and embryology, medicine presented a succession of systems and schools of doctrine founded largely on speculation. The minds of physicians were possessed by such doctrines as those of vitalism, of Brownianism, of the philosophy of nature. Here and there a good observer in pathological anatomy such as J. F. Meckel and Lobstein or an enlightened physician stands out in contrast to the dominant speculations, hypotheses and mysticism. The controversy, centuries old, as to whether disease affects primarily the solids or the fluids was still kept up with fruitless dialectics. A healthier direction was given to clinical medicine by the teachings of Schönlein, but he did not break with the prevailing ontological conception of disease as an entity, as something apart which enters the body and lives there like a parasite. Medical works published in Germany as late as the fourth decade of this century are still full of such terms as "natur-philosophische, natur-historische, rationelle, physiologische" systems of medicine, to say nothing of the ultramontane, theological system of the professor of medicine in Munich.

In the third decade discoveries in microscopical anatomy were made, surpassing in number and importance all which had come before, and forming the basis of modern histology. In Johannes Müller's work "On the Intimate Structure and the Forms of Morbid Tumors" published in 1838, we meet the first fruitful application of the miscroscope to the study of pathological anatomy, and this work may be regarded as the beginning of pathological histology in the modern sense. In the same year Schwann promulgated the cell theory as applied to animals. The fundamental error of Schwann as to the origin of cells by spontaneous generation out of a primitive blastema exerted, for many years, an unfortunate influence upon pathology and led many a good investigator to spend his force in a will-o'-the-wisp search for the development of cells out of unformed material. The blastema theory for a time dominated pathology. The plas-

tic substances of John Hunter, various pathological exudates were resolved to a large extent into blastemata and the problems which seemed most urgent were to determine the characters of these blastemata, their metamorphoses and the exact mode of formation of cells out of them; and to these delusive problems microscopists set themselves to work.

Surrounded by such ideas in the year 1844, one year after his promotion to the doctor's degree, Virchow began his work first as assistant and then as prosector in the Charité Hospital in Berlin. He must have received more inspiration from Johannes Müller, the greatest physiologist of the first half of this century in Germany, than from any other of his teachers, but he acknowledged his indebtedness also to Schönlein, that remarkable man, who, without having ever published half-a-dozen pages after his graduating dissertation, became the most popular, influential and inspiring clinical teacher in Germany. Doubtless many an impulse must have come from association with that company of ardent young investigators in medicine assembled in Berlin in the early forties, from such men as Franz Simon, Reinhardt, Leubuscher, Joseph Meyer, Remak, Traube, Du Bois-Reymond, Brücke, Helmholtz. The spirit of reform was no less in the medical than in the social and political atmosphere of the time. All of these influences of his teachers, of his coworkers, of the "Zeitgeist" must have had their effect upon the young man, but, from the beginning, Virchow's published work marked him as an original and independent genius.

In 1846, at the age of twenty-five, Virchow read before the Society for Scientific Medicine in Berlin the paper entitled "Concerning Points of View in Scientific Medicine," which was soon after published as the leading article in the first volume of the "Archive for Pathological Anatomy and Physiology and for Clinical Medicine," founded by himself and Reinhardt. This short article is in a sense the programme of the author and of the journal in which it appeared. Here is emphasized the idea that disease is not an independent being, but is life under changed conditions. Scientific medicine is the investigation of these changed conditions and of the means of removing them. Halt is called to dogmatism and speculative systems of medicine. The limits of pathological anatomy are determined. The methods of investigation and the assistance of other natural sciences must be employed in medicine. Progress can come only by experiment and observation. The immediate task is to discard philosophical systems and to set to work in collecting facts. Permit me to quote the last paragraph of this remarkable article:

"Let us not deceive ourselves about the condition of medicine. Minds are unmistakably exhausted by the many hypothetical systems again and again cast aside only to be replaced by new ones. A few more invasions per-

haps and this time of unrest will have passed by and it will be recognized that only quiet, industrious and persevering work, the true work of observation or experiment, possesses enduring value. Pathological physiology will then gradually be developed, not as the production of a few heated brains, but as the work of many patient investigators; that pathological physiology, which is the citadel of scientific medicine, of which pathological anatomy and the clinic are only out-works."

Brave words and true are these uttered by a young physician only three years after receiving his doctor's degree, words significant now, but many times more significant when they were spoken. But they were not the words of a dreamer or an idle talker. He who wrote them had already begun that "quiet, industrious and persevering work, the true work of observation and experiment," which was destined to introduce a new epoch in the history of medicine.

By a fortunate chance Robert Froriep assigned to his young assistant as a theme for independent investigation, the study of phlebitis. It would lead too far into historical detail for me to attempt to explain the position which phlebitis then occupied in pathology. Some idea may be gathered from Cruveilhier's sentence, *La phlébite domine toute la pathologie.* So firmly established at that time was Cruveilhier's doctrine that the essence of inflammation is coagulation of the blood in the veins and capillaries, that it seemed necessary to work out only certain details, such as, whether or not in suppurative phlebitis the pus is secreted by the wall of the vein. But it at once became clear to Virchow that the general doctrine rested upon no sure foundations and it was upon the foundations of the doctrine that he began to work. His preliminary studies were upon the morphology and chemistry of fibrin and the conditions for its coagulation both within and outside of the body. At the same time his attention was turned to the morphological elements of the blood, more particularly the white blood corpuscles, and here his observations on leukaemia opened new points of view on the nature and origin of the white corpuscles, so that in 1846, he could say, "Herewith I vindicate for the colorless corpuscles of the blood a place in pathology." His powers of critical analysis and correct interpretation of pathological facts were at this time brilliantly exhibited in the view which he took as to the nature of leukaemia, the same view essentially which is still held, in contrast to Bennett's conception of the disease as an haemitis, a suppuration of the blood. But it was in the epoch-making articles on "Plugging of the Pulmonary Artery and its Results" (1846 and 1847) and on "Acute Inflammation of the Arteries" (1847), that the best fruits of Virchow's studies of subjects suggested by phlebitis appeared. Here, for the first time, was there a clear insight into an important group

of pathological facts which had been the favorite study of John Hunter and which had exercised the minds of the succeeding generation of pathologists. The doctrine of thrombosis and embolism as it was here and subsequently elaborated by Virchow formed virtually a new chapter in pathology, well rounded as it left the hands of its founder, a monument of brilliant scientific investigation in pathological anatomy and experimental pathology. The important articles on "Pathological Pigments," and "The Pathological Physiology of the Blood" belong also to the same period and the same line of investigation. The fundamental part of these researches, together with investigations in many other directions in pathology, belong to the first Berlin period of Virchow's activity (1844-1849).

The Würzburg period, extending to 1856, was one of great and fruitful scientific work. Already in Berlin, by his investigation of degenerative cellular changes in Bright's disease and of inflammation of muscle, Virchow had reached new views as to the nutritive alterations of cells in inflammation; but it was in Würzburg especially that his doctrine of inflammation, which has exerted such a reformatory influence upon pathology, was worked out by himself and his pupils. In the article on "Parenchymatous Inflammation" (1852), and in that of the same year on "Units of Nutrition and Localizations of Disease," he has already conquered a large tract of cellular pathology. He has a firm grasp upon the nutritive and functional disturbances of cells. Further researches were necessary to reveal clearly their formative activities. In the light of the most recent views concerning inflammation, it is significant to note that in the first of these articles Virchow clearly recognizes suppuration as secondary to necrosis of tissue, and in this connection says, "Here there is certainly an inner, parenchymatous process, and if the subsequent suppuration be regarded as the outcome of inflammation, one need not hesitate to regard the degeneration of the parenchyma as an integral, neither consecutive nor accidental, part of the inflammatory process." And again at the close of the article, "not hyperaemia and not exudation, nor redness, nor swelling nor pain, do I put first, although I recognize their importance, but degeneration—I vindicate, therefore, before all for inflammation the character of degeneration."

But the brightest lustre of this period of Virchow's scientific work comes from those investigations which laid the foundations of cellular pathology, Like all of his contemporaries, Virchow at the beginning was under the dominion of Schwann's theory as to the spontaneous origin of cells from blastema. His researches upon the origin and structure of the connective-tissue group of substances, published in 1850, were reformatory for both pathological and normal histology. There followed a series of investigations which laid broad and firm the foundations of cellular pathology. Already in 1854 Virchow cast aside definitely the blastema theory of cell formation.

To describe further in detail these and the other investigations of Virchow in pathology up to the present time is impossible within the limits of an address. To do this would require a book covering nearly the whole ground of pathology. Into what corner of special pathological anatomy and of general pathology should we not be led if we attempted to follow the many hundred articles which he has written on these subjects? We cannot include here the consideration even of such a monumental work as that which he has written upon tumors.

I must content myself in the limited time remaining by directing your attention to a few salient points intended especially to show the reformatory character of Virchow's work in pathology.

In his beautiful oration on Johannes Müller, Virchow says, "There is no school of Müller in the sense of dogmas, for he taught none, but only in the sense of methods." The same may be said of Virchow's school. His school means not the propaganda of certain dogmas as meant the schools of the great leaders in medicine of olden times. It is the method and not dogma which characterizes it, and the method is that of the natural and physical sciences. In 1849, in the article on "The Scientific Method and Points of View in Therapeutics," Virchow wrote: "In fact, that is true which Asclepiades of Bithynia, the father of that old school of methodistic physicians, emphasized; the method of investigation is that which is essential and determining. It is the method which distinguishes the Harveys, the Hallers, the Bells, the Magendies, and the Müllers from their smaller contemporaries. This is the soul of the natural sciences."

Observe; experiment; seek the aid of allied sciences, chemistry, physics, general biology; collect by systematic and purposeful investigation, in which the "Frage-Stellung" is correct and clear, a body of facts, and from them deduce general pathological principles and laws. It is along these lines that Virchow has worked and taught. The proper uses of hypotheses in scientific investigation he has always recognized; but important as are these uses, hypotheses are not to serve as the foundation of pathological doctrines. His early opponents, the adherents of the philosophy of nature and the so-called rationalists, accused him of leading medical science into the barren collection of facts, of letting the broad river of science waste itself in countless little streams. But both by precept and example no one has demonstrated more clearly than Virchow that the scietific mind, in the investigation of details, should not lose sight of the higher aims, the orderly classification of the facts, the search after new and loftier points of view, the establishment of general principles and laws.

This method of investigation is none other than the Baconian. Virchow did not originate it. Many before him had recognized its importance, and

had applied it to medicine. Before Virchow it had already become the powerful lever of comparative anatomy, embryology and physiology. But one purpose of the historical remarks with which I began this address was to show that in pathology this method had not gained full sway when Virchow's work began, and that speculation and the construction of philosophical systems of medicine based upon speculation, were still in vogue. The application of the scientific method to pathology could not have been long delayed, but to Virchow more than to any other man belongs the credit of introducing into pathology the scientific method of investigation by the employment of which this department of knowledge has gained its rank as one of the natural sciences.

It is another great merit of Virchow to have made clear the kind of knowledge to be gained by the study of pathological anatomy. In the enthusiasm of the rapid development of pathological anatomy in the early part of this century, false and exaggerated ideas were entertained as to the relations between this subject and practical medicine and to the kind of information to be derived from the examination of diseased organs after death. The attempt was made to construct out of pathological anatomy alone, systems of pathological physiology. This led in France to such exclusive systems as Broussaisism and in Vienna to the craseological system of Rokitansky and to the nihilistic school of therapeutics, less dangerous than Broussaisism but equally unfounded. Rokitansky expressed and enforced upon his followers "the conviction," to quote his own words, "that pathological anatomy must be the foundation not only of medical knowledge but also of medical treatment, yes, that it contains everything that there is in medicine of positive knowledge and of foundations for such knowledge." Against this view Virchow pointed out that each department of medicine has its own field and must be investigated by itself and cannot be constructed entirely out of another. As he said, "Pathology cannot be constructed by physiologists, therapeutics not by pathological anatomists, medicine not by rationalists."

Pathological anatomy shows us simply the morbid changes in the organs, tissues and cells as they exist in one phase or in a series of phases. It does not show us the morbid process as it goes on in time. It does not reveal the alterations in function. Pathological anatomy is essential to pathological physiology, but the relations which these branches of knowledge bear to each other are similar to those between normal anatomy and physiology. General pathology or pathological physiology, as Virchow likes to call it, rests also upon experiments and clinical observations. It never has been and never can be successfully built up from pathological anatomy alone. Its methods are those of normal physiology. In one of his earliest publications in 1846,

Virchow said: "It would be sad indeed if anatomical investigation were compelled to confine itself to the dead material, to the recognition of the completed conditions of isolated and determined products, if the entire outcome were only the description and classifications of certain objects in nature. Pathological experiment remains ever the sure control for the pathological anatomical conclusion, and it will seldom be employed without disclosing to us new and valuable sources of knowledge." These words appropriately introduced the description of Virchow's admirable anatomical and experimental work on "Plugging of the Pulmonary Artery and its Results." All this needed to be said when Virchow said it, and it has not lost its force today.

John Hunter and Magendie were the pioneers in experimental pathology, and Virchow and Traube established pathological experiment in its impregnable position as the most powerful aid in the development of pathological physiology.

The establishment of cellular pathology is one of the greatest events in the history of medicine. That Virchow's share in this was decisive and controlling cannot be successfully contested. The historical points pertaining to the development of the principles of cellular pathology have been often and much discussed. Virchow's investigations leading to the development of this great thought in his mind are briefly referred to in chronological sequence in the article at the beginning of the one hundredth volume of his Archiv. On this occasion I cannot enter into the history of the question, save to emphasize one point which is lost sight of by some of those who have written on the matter. The discoverer of a scientific fact is not he who has divined it, but he who has proved it. The opportunities for the study of the development of animal cells are furnished chiefly by embryology and by pathology. The demonstration that all cells are derived from preexisting cells was easier to bring by the embryologist, starting with the ovum, a single cell, than by the pathologist. Hence it is not strange that embryologists, such as Reichert, Kölliker and later Remak, had discarded the blastema theory, so far as the development of the embryo is concerned, at a period when the same theory prevailed in pathology. But so long as it was not proven that in pathological formations the new cells also come from preexisting cells, this general principle of cell development could not be considered proven. It was not until Virchow had brought this part of the evidence, more difficult to obtain than the embryological and equally important, that the truth, which he was the first to frame in the words, *omnis cellula e cellula,* was fully established. The nutritive, the functional and the formative disturbances of the cells became in his hands the ground-work of cellular pathology; and although this ground-work was laid before the publication of his "Lectures on Cellular Pathology," in 1858, nevertheless these came as a revelation to most physicians throughout the world.

The principles of cellular pathology have become to such an extent an integral part of medical thought that we can hardly estimate today all that this discovery meant a generation ago. To do this we must put ourselves back in thought to a time when all organized pathological products, pus, tubercle, cancer and all tumors were supposed to be formed out of a primitive blastema, an exudation of some kind. Think of trying to come, under the influence of such ideas, to any coherent or intelligent opinions as to the nature and development of morbid processes.

The never-ending strife between humoralism and solidism would probably be going on today had it not received its death blow from cellular pathology. The termination of this strife does not mean that we are not the heirs of great truths which came out of it, or that there is any contradiction between cellular pathology and humoral or nerve pathology in the proper sense of the terms. In 1855 Virchow said, with a cast of thought perhaps derived from his political opinions: "While we contend for the *Tiers état* of the many little elements, it may seem as if the aristocracy and the hierarchy of blood and nerve were to be destroyed to their very roots. But it is here only usurpation which we attack, monopoly which we wish to overthrow; and once again we emphasize it that we fully recognize blood and nerve as equally authorized factors together with the other parts; yes, that we do not in the least question their predominant importance, but that we concede their influence upon other parts to be only a stimulating and moderating, not an absolute, one."

With the recognition of cellular pathology, it became clearer than ever before that the laws working in disease are not different from those in operation in health, but that they are subject to different conditions. The ontological conception of disease passed out of the horizon of scientific medicine.

Cellular pathology is not a system, a doctrine; it is a biological principle, as has been said by its founder. Its foundations have been attacked, but never have been shaken. The discoveries of karyokinesis, of wandering cells, of the migration of leucocytes from the vessels, and of the specific cellular germs of disease have only widened our views of cell pathology. Cellular pathology is one of those great principles in science which, when established, disclose new points of view, open up limitless fields for investigation, and receive the new results without a tremor in the foundations. How different this from the era of speculative systems and schools of medical doctrine, when every new discovery threatened the overthrow of the dominant system!

With Virchow's return to Berlin, in 1856, he had secured from the government the concession of a new pathological institute, to be constructed according to his own ideas and plans. In any estimate of the reformatory influence of Virchow upon pathology, his share in bringing about the general

recognition of the importance of establishing pathological institutes should not be overlooked. In 1858 he wrote: "As in the seventeenth century anatomical theaters, in the eighteenth clinics, in the first half of the nineteenth physiological institutes, so now the time has come to call into existence pathological institutes, and to make them as accessible as possible for all." His ideas as to the general organization of such institutes have been the controlling ones for most of those since constructed in Germany, and for many in other countries. The importance of such institutes for the instruction of students and physicians and for the progress of pathology cannot easily be overestimated. A pathological institute, constructed and conducted like the one in Berlin, requires a very considerable outlay of money, which Virchow said must come in general from the government. In this country, however, we must look in general to private beneficence to endow hospitals and medical schools with such pathological institutes as have made Germany for many years the Mecca of those from other countries who wish to study pathological anatomy.

Virchow, like his teacher, Müller, and like one of his great predecessors in Würzburg, Döllinger, has been one of those teachers who have attracted pupils in large numbers, and have exercised a powerful influence upon their thought and development. The professorships of pathological anatomy in Germany are occupied to a very large extent by those who have been under the inspiration of his personal teachings, and many in other lands are proud to call him master.

Nearly forty years ago, Virchow wrote: "There are also those who, if they do not create the current, still give to it its direction and force. These men are not always the happiest. Many go down in the movement, or by it. Many grow weary after they have given to it their best forces. Much power and great tenacity are necessary if the individual shall not only live to see his triumph, but also to enjoy it."

He who wrote these words has lived to see and today enjoys his triumph. May health and happiness be his for many years to come!

VIRCHOW

A TRIBUTE[1]

Rudolph Virchow, the great master, is gone. His death, although not unexpected, comes as a shock to the world of medicine and to the world at large. It is hard to realize what a void is left by his departure, how much poorer the world, so vastly enriched by the fruits of his work, is today by the removal of a man of character so noble, of intellect so great, of achievement so high and varied.

Virchow, the chief founder of modern scientific medicine, the highest glory in medicine of Germany and of our age, will rank for all mankind and for all time to come as one of the greatest figures in science. Important as was the reformatory influence upon medicine of the discoveries and work of the few leaders whose names are worthy to be placed besides his, such as Galen, Vesalius, Harvey, Hunter and Pasteur, it may safely be said that the establishment by Virchow of the principles of cellular pathology marked the greatest advance which scientific medicine had made since its beginning. Upon this foundation, embedded in the solid rock of truth, medicine has built for nearly two generations, and we may confidently believe that upon the same foundation future generations will continue to build with ever increasing benefit to science and to humanity. Investigation will penetrate deeper and deeper into the structure and the life of cells, but there is no reason to believe that ultimate analysis will ever be able to refer the primary seats of disease to any independent, vital units outside of the cells.

With what untiring industry, keen intelligence and skill and just discernment of the truth has Virchow cultivated for over half a century the new fields opened up by his greatest discovery, and how immeasurably has he enriched pathology in all directions by his contributions! Look up the development of knowledge concerning almost any subject in pathology, and one is almost certain to encounter the name of Virchow, and, if he is not the discoverer, it is likely that he has left the subject so illuminated that we mark the knowledge of it as that belonging to the era before Virchow and that to the era after Virchow.

Virchow was an almost universal genius. The sanitary and sociological importance of the work which first drew public attention to the young physician—his report upon the epidemic of typhus fever in Upper Silesia—is well known. Here was exhibited strikingly the independent and undaunted

[1] Phila. Med. J., Phila., 1902, X, 13.

spirit of the man who would allow no political considerations to stand in the way of truth and liberty and humanity. His services in the cause of public, especially municipal, sanitation are everywhere recognized as one of the highest importance. The obligation to devote skilled knowledge to the welfare of town and state is one of the most impressive lessons of his useful civic life, as was so well emphasized by his friend, Dr. Jacobi, in his stirring remarks upon Virchow as citizen and statesman at the New York dinner in celebration of his eightieth birthday, last October.

It is simply amazing that, with his fruitful and uninterrupted activity as teacher, investigator and author in pathology, with his editorial labors, with his interest in medical societies, with his never neglected duties as an influential member of the municipal council of Berlin and of the imperial parliament, Virchow found time for work in anthropology, ethnology and archeology, only second in extent and importance to that in pathology.

The enthusiastic and inspiring celebration of his eightieth birthday last autumn afforded opportunity for an estimation by many competent hands of the significance and value of Virchow's manifold activities. The warm tributes then so gladly paid by the scientific and medical world are still fresh in our minds, and we can but rejoice that their recipient lived to accept a homage which no conqueror in war ever merited as did our hero of science, leader, as he was, in the contest for the preservation and not for the destruction of human life.

America mourns with Germany and with all other civilized countries in the loss of this great benefactor of his race, who belongs to all time and to all the world. But more, we rejoice in the rich and abundant fruits of his long and well-rounded life. The fame of Virchow is imperishable, and his name will be held in all ages and by all peoples in grateful affection and honor.

WORKS AND PORTRAITS TO ILLUSTRATE EPOCHS IN THE HISTORY OF MEDICINE[1]

Our exhibit of works and portraits to illustrate epochs in the history of medicine is not so conspicuous an object as the pictorial display and may not attract the attention of all present, so I am glad therefore of an opportunity to say a few words on this subject. It seemed appropriate to the committee arranging the program to have an exhibit of this kind. I am not aware that any similar attempt has been made heretofore, at least not upon this scale. Very considerable embarrassment was encountered in making the selections, not so much in regard to the main landmarks, but of the authors who should be selected for the purpose of the exhibition. No book or picture has been placed in the exhibit simply on the ground of its being artistic, or to the bibliophile interesting, nor has any book been placed there simply because it was old.

The exhibit will be found in the room opposite to the entrance to this hall, not in the corridors, is arranged in glass cases, and unless one studies it systematically he will not get the proper relations of events. One should begin in the case at the reading desk in the end of the room and then follow them down in their order. This key to the exhibit (pointing to a chart), which usually hangs in that room has been brought in here for the purpose of my remarks.

You will observe what general system is adopted. Three great divisions are made, the first, representing ancient medicine, the second, mediaeval medicine, and the third, modern medicine. The ancient medicine extends from the earliest record to the time of Galen. The second, is made up of Arabian and Scholastic medicine, including the time from Galen's day to the end of the fourteenth century; the dawn of the Renaissance and modern medicine begins at the point of the Reformation in the fifteenth and sixteenth centuries.

The subdivisions of the first are arranged as follows: 1st, Egyptian medicine, which starts with the papyrus found by Ebers, its date being at least fifteen hundred years before Christ. It is a work on the remedies used in the treatment of disease, and no less than seven hundred are mentioned,

[1] Report of remarks on an exhibition of works and portraits to illustrate epochs in the history of medicine, made at the Centennial Anniversary of the Medical and Chirurgical Faculty of the State of Maryland, McCoy Hall, The Johns Hopkins University, Baltimore, April 26, 1899, including chart not previously published.

Tr. M. & Chir. Fac. Maryland, Balt., 1897-1900, IX, 24-32.

among which are opium, castor oil and other well known drugs. Next comes the Assyro-Babylonian medicine. Some of the work deciphering these cuneiform tablets has been done by our Dr. Christopher Johnston, who has a world-wide reputation for reading cuneiform inscriptions. The most of them are copies of letters written to the king and among these are letters of the physician to the king and the cuneiform inscriptions are seen in the cases together with the translation as made by Dr. Johnston.

We have next the era of Hebrew Medicine, which is so well illustrated by the book of Leviticus, and for that purpose I have selected the new translation made by Professor Driver for "Professor Haupt's Polychrome Bible." The next exhibit is a work of uncertain date, according to Max Mueller, being older than the Egyptian work. Then we come to historical medicine, beginning, of course, with Greek medicine and there you find the works of Hippocrates, the father of medicine, the greatest name in ancient medicine, and one of the greatest in the whole history of medicine, a man characterized by simplicity of work and observation without speculation and whose work has remained a model to the present time.

Aristotle was not a physician, but the son of a physician, and I have placed him next on account of his anatomical work. Finally comes the school of Alexandria, in the time of the Ptolemys where pathology, anatomy, etc., were cultivated by work on the bodies.

We pass then to Roman medicine, to the time of Asclepiades, in the second century before Christ, when he introduced Greek medicine into Rome. His original works are lost, but he was quoted most extensively by Galen and many other writers, and it is not difficult to get an idea of his opinions.

Then comes Celsus in the first century, whose work was of inestimable value, but which occupies a position quite different from that of Hippocrates and Galen. He was an encyclopaedic writer. He collected all the wisdom of those who preceded him and this is of very great value in that it preserves to us the condition of medical knowledge in the time in which he wrote. He was not recognized as an original authority and therefore he is not quoted by Galen. He was an admirer of Hippocrates and wrote in the Ionic dialect, although it had passed out of date. He clearly recognized diphtheria and his description of it is good.

The next collection, which is loaned by Dr. Kelly, shows the works of Soranus, and his work on diseases of women and children is the only one preserved to us of ancient time.

Finally comes Galen in the second century after Christ, who, as you know, summed up all the wisdom of antiquity and described that system of

medicine which held undisputed sway for over one thousand years. From that time on to the reformation there were no new contributions and his system is a wonderful monument to the man, to his powers of observation, his acute reasoning and his philosophical aid. He was the first to make physiological experiments.

Mediaeval Medicine.—This was a very dark period, as you know, in the history of medicine, nothing of value being contributed. In the Eastern Empire there were a number of writers and their works were voluminous. We know of many of the names and of the ideas of many ancient physicians through these great compilers. The first of these is Oribasius, who lived in the fourth century after Christ; then there is Paul of Aegina, who was a surgeon of experience and whose work was of considerable value in the history of surgery.

Of the Arabian period of medicine I have selected as a representative Rhazes, one of the few who actually contributed something to medicine, the rest being followers of Galen and simply transmitting his ideas. Rhazes, however, gave a good description of smallpox, and as there was no description of it previous to that time it shows positively his originality. The English translation of his description of smallpox and of measles is on exhibition.

Avicenna gives us as his greatest work, "The Canon of Medicine," which was a complete system modeled after Galen, and it was very methodic. It was translated into Latin and was for centuries the text-book of medicine; our forefathers learned their medicine from him.

With the tenth and eleventh centuries began the foundations of universities, the first of which was that of Salernum, and it is interesting to note that the university began with a school of medicine. With that I have placed Constantine of Africa, who translated the books of Avicenna and Galen. The next work was that great poem on health, rhyming in Latin, and which was translated into all languages and was as widely known, we will say, as Thomas à Kempis.

Of the twelfth and thirteenth centuries we have the works of Bernard Gordon and of Gilbert of England, the first Englishman that we know of to write medicine, and we see in these very early works the traces of the practical sense of the British physician. Numerous copies of these works were made, which became very popular and which are typical examples of scholastic medicine.

In the next century we had the dawn of freedom of thought, so free indeed, that the philosophical works of Arnold, of Villa Nova, were burned by the Inquisition. Mondino was the first from the time of the school of

Alexandria to dissect the human body. He wrote his anatomy upon this work, but he was enthralled by Galenism. That period ends with Guy de Chauliac, who wrote on the subject of surgery. He was a learned man and thoroughly familiar with his work of his predecessors.

Modern Medicine.—Now comes the beginning of modern medicine, ushered in by three movements—classical scholarship, the return to medicine, and the revolt against dogmatic authority. To illustrate the first I have selected Linacre and Caius, the first a highly cultivated man, a professor in Oxford, a very active practitioner, court physician to Henry VIII, and the physician to the great Cardinal Wolsey. This was the period of return to original work. Caius wrote a classic on Spring Sickness, and it is a monograph of that remarkable disease. It is written in the true Hippocratic spirit of actual observation; the spirit of criticism, of observation and of investigation had returned.

Then comes that great name Vesalius, the reviver of anatomy. He dissected the human body and reconstructed human anatomy. The anatomy of the ancients was based upon the dissections of animals; the anatomy of Galen was supposed to be infallible, so much so that when permission was asked of the church to dissect human bodies, the authorities answered, "It is not necessary unless Galen has made a mistake, and he has not made a mistake, therefore it is not necessary." Vesalius, however, reconstructed human anatomy; undermined Galen by pointing out mistakes made by Galen in his examinations of animals.

Next comes that strange man, Paracelsus, the antagonist of all authorities, who began his lectures by publicly burning the works of Galen and Avicenna. His main ideas were the doctrine of a conscious vital spirit that controlled the body in health and disease, and his conception of disease is interesting in that he thought of it as a parasite, as something which entered the body from the outside and entered into a struggle with the Archeus. He also contributed to therapeutics, giving new chemical and mineral remedies, the principal one of which was antimony, which became the badge of his school.

Of the practical physicians of that period I have placed Benevieni first. The next century, the century of Copernicus, gives us, first, Harvey, whose discovery of the circulation of the blood was first published in 1628, although announced by him in his lectures twelve years before. This was the greatest discovery in physiology, for it overthrew Galenism, and was of the very first importance. Hardly less important, however, was Harvey's work on the development of the embryo. The next man, Sanctorius, was the first to use instruments of precision, the first man to count the pulse—think of

that—and the first to use the thermometer. For thirty years he recorded his own weight and the weight of his ingesta and excreta.

Borelli is interesting as the founder of the chemical school, for he was the first to try to explain the phenomena of life on chemical principles. He was a cultivated man, and his work is interesting as the natural outcome of the great advances in physics about that period. Van Helmont is celebrated for having given us the modern conception of gas and for his discovery of carbonic acid gas. The school of Leyden began its famous history under Sylvius. Glisson was celebrated for his work on the anatomy of the liver and was also, as Virchow has pointed out, the first to conceive the doctrine of irritability, the fundamental property of living things. He wrote a celebrated monograph on rachitis, and I have selected that particular one for the exhibit. Willis gained fame on account of his anatomy of the brain. Sydenham, the greatest physician of the century, and one of the greatest of all times, was imbued with Hippocratic method. He saw things clearly and described clearly what he saw. His is one of the greatest names in British medicine, and I might mention particularly his graphic description of the gout, of which he himself suffered, and his writings upon hysteria, the use of bark in malaria and the use of cooling treatment in fevers, etc.

Two names that characterize the beginning of microscopic anatomy come next. About this time they began to make simple lenses, and with them Malphighi ranged over the whole subject, was the first to see the red blood corpuscles and to study the structure of the lungs, kidneys and all the glands of the body. Van Leeuwenhoek, a self taught microscopist, a linen draper by trade, discovered bacteria by means of these simpler lenses, although he did not appreciate their significance. These two men accomplished all that was possible with simple lenses, and then there was no further development for many years, not until more perfect lenses could be devised, which was not until the early part of the present century. Nothing more could be done than they did with such instruments.

Now we arrive at the eighteenth century, the philosophical century, as it is called, and it begins to be difficult to select the names. We may mention Boerhaave, Hoffmann, Stahl, Haller, Wolff and Morgagni, the first to make post-mortem examinations; possibly they had been made before and not appreciated, but he marked the introduction of what the Germans call "anatomische denken," or anatomical thinking. Then follow Auenbrugger, Hunter, possibly the greatest name in the history of scientific surgery; Jenner, the discoverer of vaccination, about whom not a word need be said to those who heard Dr. Chew's address of last evening. Next comes

Spallanzani, the first to study artificial digestion in tubes outside the body, and Galvani, an interesting name in medicine as well as in science, and to represent him I have selected a work on animal electricity.

Of the nineteenth century workers it was most embarrassing to select names, and I have no doubt that the ones I have selected are open to criticism; but one had to select, for it was impossible to put in the names of all the representative men. Bichat heads the list I have made, and is followed by Laennec, Louis, celebrated for his studies on typhoid fever; Von Baer, Charles Bell, the discoverer of the roots of sensory nerves; Marshall Hall, the discoverer of reflex nerve action; Liebig, who started the work in physiological chemistry; Johannes Müller, the founder of the modern German school of physiology; Magendie, Morton, the discoverer of anaethesia; Rokitansky, Wünderlich, whose work has made general the use of the thermometer; Von Helmholz, the discoverer of the ophthalmoscope; Virchow, the great pathologist; Lister, the first to formulate and apply the principles of antiseptic surgery, and finally Pasteur and Koch.

Many more might have been given, but workers of this century are mostly known to you. In the same room you will see Dr. J. Whitridge Williams' very interesting collection of works of just 100 years ago, the text books in use then, the journals published at that time, etc.

EXHIBITION OF BOOKS AND PORTRAITS TO ILLUSTRATE EPOCHS IN THE HISTORY OF MEDICINE

A. Ancient Medicine

I. **Egyptian Medicine.**
   Papyrus Ebers, 1500 B. C.

II. **Assyro-Babylonian Medicine.**
   Epistolary cuneiform tablets of Physician Arad-Nana (680 B. C.), translated by Dr. Christopher Johnston.

III. **Hebrew Medicine.**
   The Book of Leviticus. Prof. Haupt's Polychrome edition.

IV. **Indian Medicine.**
   Susruta's Ayur-veda.

V. **Greek Medicine.**
   Empedocles.
   Hippocrates the Great, 460-377 B. C.
   Aristotle, 384-323 B. C.
   School of Alexandria, 300 B. C. Herophilus and Erasistratus.

VI. **Roman Medicine.**
   Asclepiades, about 100 B. C.
   Celsus, first century.
   Aretaeus, first century.
   Soranus of Ephesus, second century.
   Galen, 131-210 (?).

B. Mediaeval Medicine

VII. Byzantine Medicine.
- Oribasius, 326-403.
- Aetius, 502-575.
- Paul of Aegina, 625-690.

VIII. Arabian Medicine.
- Rhazes, 850-932.
- Avicenna, 980-1036.

IX. School of Salernum. Beginning of Universities.
- Constantine of Africa, 1018-1087.
- Regimen (Sanitatis) Salernitanum.

X. Scholastic Medicine.
- Gilbert of England, 1290.
- Bernard Gordon, 1305.

XI. 13th and 14th centuries. Beginning signs of the Renaissance.
- Arnold of Villa Nova, 1235-1312.
- Mondino, 1276-1326.
- Guy de Chauliac, 1300-1370.

C. Modern Medicine

XII. 15th and 16th centuries. Renaissance. Reformation.
- Humanists: Linacre, 1461-1524. John Kaye (Caius), 1506-1573.
- Revival of anatomy. Vesalius, 1514-1564.
- Attack upon dogma. Paracelsus, 1493-1541.

XIII. Practical Medicine and Surgery in the 15th and 16th centuries.
- Benevieni, 1440-1502.
- Fernel, 1485-1558.
- Schenk of Grafénberg, 1530-1598.
- Ambroise Paré, 1510-1590.

XIV. 17th century. Development of the Natural Sciences.
- Harvey, 1578-1657.
- Sanctorius, 1561-1636.
- Borelli, 1608-1679.
- Van Helmont, 1577-1644.
- Sylvius, 1614-1672.
- Glisson, 1597-1677.
- Willis, 1621-1675.
- Sydenham, 1624-1689.
- Malphighi, 1628-1694.
- Van Leeuwenhoek, 1632-1723.

XV. 18th century. "The Philosophical Century."
- Boerhaave, 1668-1738.
- Fr. Hoffmann, 1660-1742.
- Stahl, 1660-1734.
- Haller, 1708-1777.
- C. F. Wolff, 1733-1794.
- Morgagni, 1682-1771.
- Auenbrugger, 1722-1809.
- John Hunter, 1728-1793.

Jenner, 1749-1823.
Spallanzani, 1729-1799.
Galvani, 1737-1798.
Other important, though less notable, physicians and surgeons of this century: Lancisi, J. L. Petit, Cheselden, Mead, William Hunter, Hewson, Von Swieten, Desault, the Monro's, Baillie, Smellie, Brown, Cullen, Fothergill, Pringle, Pinel, Rush, Reil, Bordeu.

XVI. 19th Century.
Bichat, 1771-1802.
Laennec, 1781-1826.
Louis, 1787-1872.
Von Baer, 1792-1876.
Charles Bell, 1774-1842.
Marshall Hall, 1790-1857.
Von Liebig, 1803-1873.
Magendie, 1783-1855.
J. Müller, 1801-1858.
Administration of ether at the Mass. Gen. Hospital, by William Morton, on October 16, 1846.
Rokitansky, 1804-1878.
T. Schwann, 1810-1882.
Wünderlich, 1815-1877.
Virchow, 1821-1902.
Helmholtz, 1821-1894.
Pasteur, 1822-1895.
Lister, 1827-1912.
Koch, 1843-1910.

MAJOR JAMES CARROLL, M. D., U. S. A.[1]

I recall well Carroll's first appearance in the laboratory. He had entered the army as a private soldier in the ranks and was then a hospital steward. Dr. Pilcher and Dr. Price, army surgeons, helped him to obtain a medical education, and he had just come from a course of lectures in New York City.

Walter Reed was sent here in 1889 by the Surgeon General with instructions to attend the clinics of Osler, Kelly and Halsted and to leave the laboratories alone. A not altogether wise Surgeon General. But later Sternberg became Surgeon General. Himself a pioneer in laboratory experimental work, he urged Reed to undertake the same.

I well remember the joy and inspiration with which Reed entered the laboratory and undertook the work. He seemed overcome with the opportunity afforded him. There was an unusual group of men working in the laboratory then; Councilman was my first assistant; Flexner had just come; Lafleur, Thayer, Barker, I think Abbott and Nuttall were all there. A rather interesting family! And Reed was taken in and of course influenced by them all.

Reed acquired his bacteriological training here; he took the elementary courses and afterwards carried on work independently. It was during this period that Carroll came to assist him. Carroll was still a hospital steward and hence subordinate to Reed, helping him to make media, assisting in experiments and doing the simpler things. Carroll's peculiar aptitude soon became evident, however, and he was allowed to take the regular courses.

This was his first introduction to Reed, and their association was later continued in work carried on in the Army Medical Museum in Washington.

Reed established his reputation as a creative investigator in bacteriology in a short time. While here he was interested in reproducing the focal necroses in the liver found in typhoid fever by injecting the typhoid bacilli into the vessels leading to the liver, and these lesions hitherto considered lymphomata were proven to be simply necroses. This was a very pretty piece of work. He also made a study of the diphtheria bacillus. And so when called to head the commission he was recognized by all as qualified for the position.

[1] Report of an address given at The Johns Hopkins Hospital Historical Club, in memory of Major James Carroll, M. D., U. S. A., Baltimore, October 14, 1907.

Johns Hopkins Hosp. Bull., Balt., 1908, XIX, 6-7.

Carroll was very intimate with Reed and Carroll's training and reputation were due to this association. They frequently came back here together to attend lectures, two or three times a week, and kept fully in touch with the research work going on in the laboratories.

It was from insight into his character that Reed was selected as leader of the commission, but no one could have been found as a more efficient aid to Reed than Carroll. Lazear was the third member. Dearly loved here and a member of Osler's staff, he was more broadly educated clinically and pathologically than any other man upon the commission. He was unusually well prepared for this work by having studied the mosquitoes and malaria with Thayer. Agramonte was immune and a most useful member.

This unusual piece of scientific work before the commission was accomplished by the most economical method. Sternberg had done all that could be accomplished with the known bacteriological methods to ferret out a specific organism as the cause of yellow fever. A commonplace experimenter would have pursued that line, and a sterile research would have resulted. There were a number of points of attack, only one of which, however, appealed to Reed as useful. That was the isolation of an organism from the stomach and intestines which would be agglutinated by the patient's blood.

The mosquito theory of yellow fever had been brought forth by Finlay in 1881, twenty years before. The work was discredited, and a special lack of credence was given it because of the discovery by Finlay of a micrococcus, a tetrad, as the specific organism. Finlay's attempts to demonstrate the rôle of the mosquito were in vain, and we now know the reason. The blood of the patient contains the virus only during the first three days of the disease and the mosquito is unable to transmit the virus until an incubation period of twelve to fourteen days is passed. But I think great credit is due Finlay for sticking to his theory through thick and thin. And I am glad the Liverpool School of Tropical Medicine has recognized Finlay, along with Gorgas and Theobald Smith awarding them medals for their work in tropical medicine.

The commission, I believe, shared in the popular lack of credence of the mosquito theory. But I know of no piece of work so well undertaken to get the answer from nature. They first settled definitely that Sanarelli's *Bacillus icteroides* was not to be found constantly in the blood. The second question they took up was, Is the virus of yellow fever present in the blood? This involved experiments upon human beings with the virus of one of the most deadly diseases. Would you undertake it? I cannot say that I would. And yet it was not done rashly. The great responsibility was fully realized by Reed. Failure, involving the death of some of the patients, without

throwing any light upon the disease, would have made the experiments the subject of great reproach.

But it has been one of the greatest triumphs of scientific medicine, the means of saving thousands of lives. And the courage in those men to make that experiment is ever to be wondered at.

They determined that the virus was in the blood, and that during the first three days the blood would convey the disease by inoculation. Of course, the same is true of malaria, and this does not reveal the nature of the organism. Every student should read the original three articles. For clearness of presentation and absolutely convincing proof they are unexcelled.

Carroll was the most heroic in this work, as he was the first victim. Lazear performed the first experiment but Carroll was the first to submit to the bite of a twelve day mosquito. And his was the most severe attack of all. Fortunately no case died during these very carefully planned experiments of the commission.

The commission demonstrated:

1. The futility of Sanarelli's claims.
2. That the virus is in the blood.
3. That the virus is conveyed by the Stegomyia mosquito.
4. That the patient is a source for transmission only in the first three days of the disease.
5. That the virus must then undergo an incubation period in the mosquito of twelve to fourteen days.

I was perhaps the first to suggest to Reed the importance of testing the filtrate of the blood of a patient. Carroll was designated to carry out these experiments, important in placing the virus among the class of filtrable viruses. The working party sent out by the Pasteur Institute later confirmed this work.

Reed was the leader in fact and name, but Carroll was well trained for the work. A virile, manly and courageous type, willing to sacrifice his life! The most heroic of all the members.

But Reed was no coward. He was ready to submit himself as a victim, and thought that he ought to return and do so, even when it was unnecessary. But he was forbidden to do so by Gen. Sternberg, I think. Lazear also was a hero.

What a service to mankind! Is there anything comparable? Jenner's? Yes, I think so! The commission proved that complete eradication from the face of the globe of the greatest and most dreaded pestilence that affects mankind is possible. A disease which in a single epidemic has caused the loss commercially of ten millions of dollars to such a city as New Orleans. And in the construction of the Panama Canal our country is demonstrating

to the world the value of the commission's work. It was an inestimable service to mankind.

One other matter. After such an unselfish life, Carroll has died, leaving a widow with seven children to educate, in needy circumstances. And I propose (and I am grateful to Dr. Cattell, the editor of "Science," for the suggestion) that we make it the sentiment of this meeting to apply to the Carnegie Hero Fund for contribution for the support of Major Carroll's widow and children.

I know of no more deserving disposition of the fund, of no hero more worthy!

FRANCIS DONALDSON[1]

Mr. President, Members of the Faculty, Ladies and Gentlemen.—I esteem it a great privilege to serve as the intermediary in behalf of representatives of the family of the late Dr. Francis Donaldson, particularly of his daughter, Mrs. Waters, in the presentation to the faculty of the portrait of one whose memory we cherish and love and who for over forty years was a leader in our profession in this city.

Dr. Donaldson belonged to the generation beginning their professional work in the thirties and early forties of the last century, when a new era was introduced into American medicine, which was nowhere more strikingly marked in the advancement made and in the contrasts between the earlier and the later periods than here in Baltimore. Up to the fourth decade of the nineteenth century the dominant influences had come from Edinburgh and to a less extent from London, and the medical systems of Cullen and of Rush swayed the minds of physicians. This older school was well represented in Baltimore by such men as Dr. Davidge and Dr. Nathaniel Potter.

The new medicine arose in France with the introduction of the methods of physical diagnosis of diseases of the heart and lungs by Corvisart and by Laennec and with the systematic anatomical study of disease at the post mortem table by Bichat, Bayle, Laennec, Cruveilhier. A remarkable group of enthusiastic and able young American physicians, pupils mostly of Louis, Andral and Chomel, brought the new ideas to this country and thereby infused a fresh spirit most invigorating in its influence. The pioneer and apostle of this new movement for Baltimore was William Power, who returned to this city in 1840 after five years of foreign study, mainly with Louis.

Dr. Donaldson came under these influences in his student days. Born in 1823 he began his study of medicine in 1842 as an office student of Dr. Samuel Chew, the elder, and was graduated doctor of medicine at the University of Maryland in 1846. The university, after years of dissension among the regents, the trustees and the faculty, had shortly before entered upon a period of peace and prosperity, when the conditions for medical

[1] Report of remarks made at the presentation of the portrait of Francis Donaldson to the Medical and Chirurgical Faculty of the state of Maryland, Baltimore, April 25, 1911.

Bull. Med. & Chir. Fac. Maryland, Balt., 1911, III, 174-179.

study here were not surpassed elsewhere in this country. Nathaniel Potter died in 1843, and another link with the past, Richard Wilmot Hall, the professor of obstetrics, lingered until 1847. Nathan R. Smith, the greatest figure of his day in medicine in this state, had assumed unquestioned leadership and, like his father, was an original and independent thinker and surgeon. Aikin, so long and usefully identified with the university, had succeeded in 1837 the eminent Ducatel in the chair of chemistry, and Samuel Chew, like his son, a highly cultivated gentlemen and accomplished physician, was at this time professor of materia medica. In 1842 there came from the North to fill the chair of anatomy, Joseph Roby, a remarkable man and one of the best teachers of this subject in this country. Great stimulus and inspiration must have come from the teaching of Elisha Bartlett, whose life and work have been so charmingly depicted by Dr. Osler, when he gave the only course of lectures which he delivered at the university during his two years incumbency of the professorship of practice. He had already published his memorable work on typhus and typhoid fevers. William Power began the teaching of physical diagnosis in 1840 and gave lectures upon practice in 1845-46, succeeding in the latter year to the chair, which he held with brilliant success until his lamented death in 1852 from pulmonary tuberculosis. George W. Miltenberger, who graduated in 1840, was the demonstrator of anatomy, and fellow-pupils with Donaldson were Charles Frick, Christopher Johnston, and William C. Van Bibber. Certainly this group of physicians—Miltenberger, Johnston, Frick, Donaldson, and Van Bibber—all graduating at the University of Maryland between 1840 and 1846, all closely associated in intimate friendship, and all attaining leading positions in the profession was a remarkable one.

We are accustomed to picture in colors much too dark the teaching and the conditions of medical training at this period. Dr. Donaldson in his admirable biographical sketch of Dr. Charles Frick, as well as Dr. Van Bibber, in his touching tribute to Dr. Donaldson at the memorial meeting of the faculty, have sketched for us something of the life of the medical student in those days. Valuable practical training was open to these and other students by residence as interne at the Baltimore Almshouse, Drs. Power and T. H. Buckler being among the visiting physicians when Donaldson was a resident student. The zeal and enthusiasm of these young men were not less ardent than of the best students of today, and they read and worked hard under the guidance of excellent teachers.

Dr. Donaldson spent the two years following his graduation in foreign study, chiefly in hospitals of Paris, where he enjoyed the teaching and influence of Louis, Andral, Chomel, and Trousseau. I have heard him speak of the inspiration derived from those great teachers and clinicians. When he re-

turned to Baltimore in 1848, he brought with him excellent training in physical diagnosis, interest in pathological anatomy and physiology, and the ideas of the new era in medicine represented by the group of young American physicians trained in Paris at this period. For two years, until 1850, he served as resident physician in the Marine Hospital, Baltimore, and from 1852 to 1855 was attending physician at the Almshouse.

The direction of Dr. Donaldson's main professional interests was already indicated by his early papers. Thus, in 1851 he published in the "American Journal of the Medical Sciences" an article on "Claude Bernard's Recent Discoveries in Physiology" and in 1853, "The Practical Application of the Microscope to the Diagnosis of Cancer," and "On Recent Improvements in Auscultation in Diseases of the Lungs." His reputation as an expert in physical diagnosis was soon established and was retained throughout his life. Upon this last subject he made a number of reports and contributions to the Medical and Chirurgical Faculty and elsewhere, and it is especially for his knowledge and skill in the diagnosis and treatment of diseases of the chest that he is best remembered by his professional colleagues. With this he early associated the diseases of the throat. He was one of the earliest, if not the first, to practice laryngoscopy in this city and was a member of the American Laryngological Association, founded in 1878.

Dr. Donaldson from the beginning of his professional life was actively identified with the interests of the Medical and Chirurgical Faculty, and served efficiently as secretary from 1851 to 1855. It deserves to be remembered that as early as 1855 he offered a resolution to the faculty that a committee be appointed to memorialize the next legislature for the enactment of a law for the uniform registration of births, deaths, and marriages throughout the state. The resolution was adopted, the committee appointed, a bill framed which passed the lower house by nearly unanimous vote, but it did not advance further, although the agitation for it continued for some time. It was only a few years ago that we obtained under considerable difficulty the enactment of vital statistics law for the state, and even this falls short of an entirely satisfactory measure.

In 1853 Donaldson joined with Charles Frick, Thomas H. Buckler, Christopher Johnston, William C. Van Bibber, David Stewart and a few others in founding the first Baltimore Pathological Society which continued in active operation until 1858. This society, supported by the rising talent in the profession, represented a higher standard of scientific activity than any previous medical organization in the city, and Dr. Donaldson was an active contributor to its proceedings, which were recorded by the secretary, Dr. Van Bibber, in the "Virginia Medical Journal." It is interesting to note that as early as 1847 Dr. Miltenberger lectured on pathological anatomy

at the University of Maryland, and, it would appear, stimulated much interest in the subject among his pupils.

With the exception of his connection in 1852 with the Maryland Medical Institute, a preparatory medical school started in 1847, Dr. Donaldson's career as a teacher began in 1863 with his appointment to the chair of materia medica in the Maryland College of Pharmacy, a position which he resigned upon his election in 1866 to the professorship of physiology, hygiene, and general pathology and the clinical professorship of diseases of the throat and chest in the University of Maryland, only the clinical chair being retained after 1880 until his retirement as emeritus professor in 1888. His introductory lecture upon assuming the duties of the chair of physiology has the significant title, "Physiology the True Basis of Rational Medicine," and scarcely less so is that of the address which he gave at the following commencement—"Medicine an Aggregate of Progressive Sciences." Pathology he taught by weekly lectures in which he exhibited morbid specimens obtained from Bay View and other hospitals. I have been told that as a teacher he was concerned in affording the students opportunities for practical observation, and that his pupils felt that he had a personal interest in their welfare.

Many instances are told of Dr. Donaldson's tact and kindly efforts in aiding young physicians in whom he was interested to establish themselves in practice. There is no more engaging trait of the successful physician than his willingness by word and deed to further the success of young physicians entering upon the work of their profession.

In 1882 Dr. Donaldson, as president of the Medical and Chirurgical Faculty, delivered an address of unusual interest. In the light of later developments, we recognize his wisdom in emphasizing the organization of county medical societies and the more liberal support of the library in order to stimulate the interest of physicians and to promote the growth of the society. The main part of the address was devoted to the presentation of the recent discoveries of Pasteur and Koch. The discovery of the tubercle bacillus had just been announced, and, in view of the skepticism with which this announcement was received by many, especially in this country, it was certainly a man of wide vision who spoke these words, which come near the close of the address: "Even just now we learn by the telegraph that Tyndall has communicated to the London Times the results of Koch's investigations and discoveries where we least expected it. It is claimed by Koch, a very careful and by no means hasty man in his conclusions, that he has discovered the parasite or bacillus which causes tuberculosis"—and again after describing some of the details of Koch's discovery, he says: "No one can estimate the value of these researches; how far-reaching they may be, can be inferred

when we remember that one-seventh of the deaths of the human race are due to tubercular diseases, while fully one-third of those who die in active middle age are carried off by the same cause. . . . . Every heart in this assembly will respond to the prayer that Koch's results may be fully verified. It would indeed be the glory of the century." It is evident that Dr. Donaldson thus early foresaw from Koch's discovery possibilities of benefits to mankind, which, considerable as they already are, are even yet but imperfectly realized.

Pulmonary tuberculosis is a subject in which Dr. Donaldson was greatly interested and regarding which he advocated views in some respects in advance of those prevailing at the time he wrote. In his discourse entitled, "The Influence of City Life and Occupations in Developing Pulmonary Consumption," delivered before the American Public Health Association in 1875, as well as in later papers and addresses, he advances views not so familiar then as now regarding the relation to tuberculosis of occupations, crowding, foul air, conditions of living, particularly in households, and the value of fresh air in prevention and treatment. He was an early teacher of the gospel of fresh air and he prepared a popular leaflet upon this subject which he used to distribute among his patients.

Without attempting an exhaustive search I have counted over thirty titles of medical papers and addresses contributed by Dr. Donaldson, the majority relating to diseases of the heart, lungs, and throat. The largest and most important of these contributions is his admirable and exhaustive article on diseases of the pleura occupying one hundred and fifteen pages in Pepper's "System of Practical Medicine by American Authors," published in 1885. This publication widely extended Dr. Donaldson's reputation.

Dr. Donaldson was one of the original members of the Association of American Physicians founded in 1886, and of the American Climatological Association, founded in 1883, of which he was president, as well as of various other national societies.

Dr. Donaldson belonged to a type of physician represented in this city, as well as in Philadelphia and Boston, more frequently than in most other cities of this country—the cultivated, courteous gentleman of good family and social position, influential both in the profession and in the community, hospitable and a real power for good in the life of the city. With his sympathetic personality combined with energy and enthusiasm, and the charm of winning and lovable qualities of mind and heart he inspired in his patients that confidence which has real therapeutic value in the practice of the physician, when combined with knowledge and skill.

I recall with pleasant and grateful memory a circle of leading physicians who were contemporaries and close friends of Dr. Donaldson and all active when I came to Baltimore in 1885, but who have since passed over to the

majority. Among the names which come to my mind are those of Miltenberger, Christopher Johnston, Van Bibber, Howard, O'Donovan, H. P. C. Wilson, Miles, Chisholm, P. C. Williams, James Carey Thomas, Alan Smith, Ferdinand Chatard. Of this group we rejoice to have still with us Dr. Samuel C. Chew, fourteen years younger than Dr. Donaldson, one of the most honored, beloved and eminent physicians of his generation in this city, and whom we still regard as our leader in the profession.

We do well to cherish the memory of such ornaments in our profession as was Francis Donaldson, who for nearly half a century exemplified the best ideals of the physician and the citizen. Now, twenty years after his death, his portrait has been painted from a photograph by Miss Stone, an accomplished artist, who had not the advantage of knowing Dr. Donaldson personally. To the generosity of Mrs. Waters, the daughter of Dr. Donaldson, the faculty owes this valued possession, and I beg to express to her the grateful appreciation of the members. In her behalf, I now have the privilege and honor, Mr. President of presenting this portrait to the Medical and Chirurgical Faculty.

JOHN SHAW BILLINGS

I[1]

The extraordinary extent and variety of Dr. Billings' activities make it impossible on this occasion even to enumerate, still more so adequately to characterize his important services.

From Dr. Mitchell's interesting sketch, which you have just heard, of Dr. Billings' remarkable services in the Civil War—a phase of his career so overshadowed by later achievements as to have been in danger of oblivion, had it not thus been rescued for us—it is evident that even as a young army surgeon, Dr. Billings had begun to manifest those qualities of skillfulness, efficiency and resourcefulness exemplified so strikingly in his more familiar, later work.

Dr. Osler has spoken of the central and greatest achievement of Dr. Billings' life, which will perpetuate his fame for all time—the building up and development of the great library of the Surgeon-General's Office in Washington and his monumental contributions to medical bibliography. This work, to which he devoted thirty years of almost unparalleld energy and labor, constitutes probably the most original and distinctive contribution of Amercia to the medicine of the world. It is remarkable and hardly to be expected that the work of this highly specialized bibliographical character should have been produced in a new country and by an army surgeon.

Speakers who are to follow will pay tribute to Dr. Billings as Chairman of the Board of Trustees of the Carnegie Institution of Washington, and especially as the librarian of New York Public Library, in which capacity since 1896 he has done on a larger scale a great, constructive work rivalling in importance that previously accomplished in Washington.

It remains for me to call your attention briefly to certain other aspects of Dr. Billings' career, which, although in a sense incidental to the main work of his life, are nevertheless important. One of these is his work in connection with the construction and organization of hospitals—a field in which he became our leading authority and acquired international reputation.

Dr. Billings' interest in hospital construction can be traced to his experiences as a surgeon in our Civil War, in the course of which there was developed a new style of building hospitals, consisting in a central administrative

[1] An address delivered at the memorial meeting in honor of the late John Shaw Billings, held in the New York Public Library, New York City, April 25, 1913.

Bull. N. Y. Public Library, N. Y., 1913, XVII, 511-535.

building with barrack-like pavilions, either detached or connected by corridors. In the promulgation, if not in the origination, of this method of hospital construction, known in Europe as the "American system," Dr. Billings had the largest share through his valuable report on "Barracks and Hospitals," published in 1870 and through his work in planning and describing hospitals, especially The Johns Hopkins Hospital.

Dr. Billings was one of the five eminent physicians selected by the trustees to prepare essays regarding the best plans to be adopted in the construction and organization of the hospital for which Johns Hopkins had provided the largest gift of money which had been made up to that time for such a purpose. His essay was chosen as the best, and from 1876 to the opening of the hospital in 1889 he acted as the highly efficient medical adviser of the trustees of The Johns Hopkins Hospital, whose confidence he enjoyed in the highest degree.

The building of The Johns Hopkins Hospital, with its admirable arrangements for heating, ventilation, isolation, sanitary cleanliness and nursing, and especially those "for joining hands with the university," as Dr. Billings expressed it, in the work of medical education and discovery, marked a new era in hospital construction, for which Dr. Billings deserves the chief credit. When one considers the influence of this hospital upon the construction of other hospitals and the valuable contributions made by Dr. Billings to the solution of various hospital problems, when one also regards the uses which have been made of this hospital in the care and treatment of the sick, in the training of students and physicians and the promotion of knowledge, it is evident that Dr. Billings' services in the field we are now considering were of large and enduring significance. I esteem it a privilege on this occasion in behalf of my colleagues and of the trustees of The Johns Hopkins Hospital and University to express our sense of indebtedness and gratitude to Dr. Billings for his pioneer work in preparing the soil without which the seed could not have been planted and ripened.

For many years there was scarcely an important hospital in this country to be constructed or remodelled concerning which Dr. Billings' advice and often active assistance were not sought. His work in this connection, added to his experiences as an army surgeon, early drew his attention to the science and art of sanitation, in which he became a writer and authority of eminence, being in certain directions our leading sanitarian during the quarter of a century from 1870 onward.

His publications in this field related naturally at first to military hygiene, and later were concerned with "Principles of Ventilation and Heating," municipal hygiene, mortality and vital statistics and other sanitary subjects. Dr. Billings was vice-president of the short-lived National Board of Health, established by the government in 1879. The withdrawal by

Congress of support of this highly promising service of the government set back, we may believe, for many years the advancement of the public health interests of this country.

Of fundamental importance to public sanitation was Dr. Billings' work in the collection and analysis of the vital and social statistics of the tenth and eleventh censuses in 1880 and 1890—a contribution which made him our foremost vital statistician.

When Dr. Billings upon his application retired after over thirty years service from the army it was to assume the professorship of hygiene and the directorship of the new laboratory of hygiene in the University of Pennsylvania. Although he was so soon withdrawn from this position to the New York Public Library that this period is hardly more than an episode in his career, yet he remained long enough to demonstrate that his conception of the organization of the new department was along broad lines and gave promise of successful results.

Dr. Billings was not only the greatest of medical biblographers, he was also a noteworthy contributor to medical history and lexicography. He delivered a course of Lowell lectures on the history of medicine and he was for several years lecturer on the history of medicine in The Johns Hopkins University, where before the opening of the hospital, he had been lecturer on hygiene. His elaborate article on the history of surgery in the "System of Surgery," edited by himself and Dr. Dennis, is probably the most valuable contribution to the subject in the English language.

A final word as to Dr. Billings' influence upon the medical profession. He was a leader of the profession. His name and that of his intimate friend of many years, Dr. Weir Mitchell, whom we still delight to honor as the chief ornament of American medicine, were of all the physicians of this country the two best known in Europe. Dr. Billings was the one most frequently sought for and chosen to represent this country in international medical congresses and public occasions of importance. His leadership was based upon intellectual power and above all upon strength and integrity of character. He was a singularly wise man combining with far-sighted vision critical judgment, the gift of persuasion, and practical good sense. To an incredible capacity for work he joined a high sense of duty and a just appreciation and sympathy which secured the loyal devotion of his coworkers. His perspective was true, removed as far as possible from all narrowness of view.

In certain of his general addresses, notably those at the Centennial Exhibition in Philadelphia in 1876, at the International Medical Congress in London in 1881 and before the British Medical Association in 1886, Dr. Billings' estimates and criticisms of the achievements of American medicine, while entirely fair and by no means lacking in appreciation, were so frankly

free from any spirit of provincialism or chauvinism that they gave offence in certain quarters of this country, but he said what at the time needed to be said, and the influence was salutary.

The name of Dr. Billings will always hold a place of honor in our profession. As I see in this audience many of my colleagues of the medical profession, I know that they will desire me to express in their behalf and in behalf of the entire medical profession of this country, the large indebtedness which we owe to the life and work of this man of large achievement, of high character, of enduring, beneficial influence upon this country.

II[1]

I regard it as one of the greatest influences of my life to have known John Shaw Billings. I first became fairly well acquainted with him when I was a student in a pathological laboratory at Leipzig. Billings came there that winter. He came often to the laboratory and the evenings we spent with him in Auerbach's Keller talking about all sorts of things were delightful experiences. He had already written about The Johns Hopkins Hospital and was full of the future of this institution. I saw then one side of his activities, the most characteristic in a way, his extraordinary love of books and knowledge of medical literature.

The central work of Billings was of course the Library of the Surgeon-General's Office, and the museum, enduring for all time. I question whether America has made any larger contribution to medicine than that made by Billings in building up and developing the Surgeon-General's Library and in the publication of the Index Catalogue and the "Index Medicus." That in my judgment is America's greatest contribution to medicine, and we owe it to this extraordinary man. Enough has perhaps been said as to the qualities of the man who organized and developed that great work. Dr. McCaw has rescued a little chapter in his life about which few knew anything—his experiences as an army surgeon. It is interesting to know how his experiences as an army surgeon influenced his subsequent work. The fact that he was an army surgeon brought him into the Surgeon-General's Office in Washington; and the opportunity offered there enabled him to develop this great library.

The other work which he did during the thirty odd years of his connection with that library was in a sense incidental to his work as librarian of the

[1] Report of remarks made at a special memorial meeting of The Johns Hopkins Hospital Medical Society, Baltimore, May 26, 1913.
Johns Hopkins Hosp. Bull., Balt., 1914, XXV, 251-253.

Surgeon-General's Office. Nevertheless this other work was highly significant. He was for a time our leading authority in hygiene in this country, at least in certain important branches. He was actively interested in the work of the American Public Health Association in its early days. I have no doubt that his interest in hygiene came from his experience in the war. In fact, his early publications indicate that; one being on hospitals and barracks; another, on army sanitation which appeared about 1870. Thus, one can trace from his army experience, the work of the library, and also his work in hygiene. The latter of course is not surprising, because an army surgeon should be interested in hygiene and sanitation, as the natural result of his professional interest. Not so, however, his interest in bibliography and the building up of a library, an extraordinary and absolutely unique work for an army surgeon, in a young country like ours. When asked what America had contributed to medicine, one would not expect to reply, the building of a library and preparation of an Index Catalogue. One might expect it in France or Great Britain. Nevertheless, that is our contribution, and as Thayer has said, the Surgeon-General's Library has had a marked influence upon the medical outlook in this country. Greater justice is done to the discoverer in medicine here than elsewhere, and a much more careful effort is made to see that a full record is kept of what has already been done, so that historical justice may be given to previous work; thus the very characteristics of our medical literature are in a sense a tribute to Billings' work.

His work as a hygienist was important. He was the greatest authority on everything relating to sanitation, hospital construction, heating and ventilation. He was the greatest vital statistician this country has produced. His connection with the tenth and eleventh census was of the first significance. The character of the data collected for them was due to the thought which he gave to the subject, and his analysis of the vital statistics of cities in connection with the eleventh census was a most important work. Billings was the Cartwright lecturer at the College of Physicians and Surgeons in New York in the late '80's and his lectures were devoted to this subject. It is not surprising when he retired from the army, that he should have been selected to be professor of hygiene in the newly founded laboratory of hygiene at the University of Pennsylvania.

Dr. Norton I think is under misapprehension as to his fame. His was our most famous name, so far as European reputation is concerned, with the possible exception of Weir Mitchell, during the decades between 1870-1890. He had the widest acquaintance and was the most highly esteemed of American physicians. He was the one whose presence was desired to represent American medicine on special occasions. He was the recipient of honorary degrees from Dublin, Edinburgh and Oxford. His was a great name and a great influence in the world of medicine.

His influence was also great upon American medicine. I believe he had the making of a great surgeon, but he was withdrawn from active practice. When one considers that he was a librarian, a bibliographer, a writer on hygiene and on sanitation, it is remarkable what his influence was. Of all the men I have ever known, he was about the wisest. He was a man whose judgment one sought on any difficult subject, and one pinned one's faith to him more than to any man of one's acquaintance. He was wisest because he was under no illusions. He got at the heart and essence of things. He was an eminently sane man, who knew what it was best to do under the circumstances, and what it was practicable to do. This quality was associated with a wide vision and high ideals. Some of his utterances were much resented by the average physician—the somewhat chauvinistic American doctor. Read two of his addresses which made a great stir at the time. One is the centennial address at Philadelphia in 1876 on American medicine. And above all, read the address which was resented by some members of our profession, "Medicine in America," given before the British Medical Association in 1886. Somewhat facetiously, but fairly seriously, he discussed the subject of malaria, and declared that certain portions of this country had been rather sterile in the matter of investigation and prevention. He was half jocose, but at the same time he candidly stated how meager our contributions had been. This view was the opposite of the usual Fourth of July, spread-eagle style of address, but it was well to have said; and he said it well! At the same time I would not convey the impression that he was not a patriotic American. There was none more so, but he put things exactly as they were. He was a lover of truth and he would spare nothing in order to reach the truth and kernel of a question.

He was not an educator, but of course his influence on American education was considerable. As has already been pointed out, what this hospital is today is mainly the thought of Billings. He conceived of it as a place not only for the care of patients, but for teaching and for investigation—the three great functions of a hospital. All three were conceived of as essential parts of the work. He was here as the adviser of the trustees of the hospital from about 1876, I think, or 1877, until the time when the hospital opened. They would have been only too glad to have had him become superintendent of the hospital. It would have been a pity in a sense to have him give up his great work in Washington. Billings gave several courses of lectures on medical education at the university, and later at the hospital.

The medical school was famous before it existed. There was a great deal of discussion as to what the school was going to be, and no one had more influence than Billings. There was a little medical faculty here even before I came in 1885. The hospital opened in 1889 and the medical school in 1893,

but the records of our medical faculty begin before the opening of the hospital and the medical school. There was a little group, consisting of President Gilman, Ira Remsen, professor of chemistry; Newell Martin, professor of biology and Billings, and the data collected by them are extremely interesting. When we planned to open the medical school, our most perplexing problem was the question of requirements for the admission of students—elaborate requirements which represented such a step beyond what existed a that time! Not even a high school requirement generally existed then. We were alarmed at the prospect and had no formal opening of the medical school. We feared that nobody would come, because we felt that we ourselves could not have gotten in and we did not know whether any such students as we desired existed at that time. Billings was in our councils, and one of his contributions was a little publication privately circulated, in which he gave the requirements for the doctor's degree in all the leading universities in the world. One may imagine how helpful that was when we were endeavoring to determine our requirements for admission.

Nothing has been said about the work of his later years as librarian of the New York Public Library. He supervised the erection of its building and the consolidation of the three important foundations—the Astor, the Lennox, and the Tilden. He organized the library which in New York they believe to be his greatest work. At the recent memorial meeting in the Public Library—a most interesting meeting—Andrew Carnegie, Weir Mitchell, Osler, John L. Cadwalader and others spoke, and emphasis was laid upon it as his greatest and most important work. One can see how great the man was, when just at the end I can only touch upon what many belive to be his most important work. I do not so believe it to be. I think that the building up of the library in Washington and the publication of the Index Medicus and the Index Catalogue were his greatest contributions. Osler says that the fame of bibliographers lives. Haller will probably be known longer as a bibliographer than as a contributor to knowledge, as will also Gesner. And Billings is the greatest bibliographer in the history of medicine.

NATHAN SMITH, M. B., M. D.[1]

The medical profession and all interested in the history of medicine in this country owe a large debt to Mrs. Alan P. Smith for the preparation of "The Life and Letters of Nathan Smith," one of the most interesting and important figures in the history of American medicine. It is eminently fitting that this work should issue from the Yale University Press as a contribution to the celebration of the centennial anniversary of the opening of "The Medical Institution of Yale College," of which Dr. Smith was as organizer and chief ornament.

The main sources hitherto available for what is known of the life of Nathan Smith have been the addresses of Dr. Jonathan Knight and of the Rev. Dr. William Allen, delivered and published shortly after his death in 1829, the "Medical and Surgical Memoirs" by his son, Dr. Nathan R. Smith, published in 1831, and especially the "Historical Discourse" by Dr. Oliver P. Hubbard, printed in 1880, to all of which repeated reference is made in this book. The many scattered estimates and accounts, mostly of an incidental nature, of the life and work of this remarkable man in medical writings have been drawn in the main from the foregoing sources.

To this rather meager fund of information a substantial addition has been made by the painstaking and devoted investigations and labors of Mrs. Smith. Especially interesting are Dr. Smith's hitherto unpublished letters, particularly those, covering a period of nearly a quarter of a century, to his friend and pupil, Dr. George Cheyne Shattuck, an eminent physician of Boston and a benefactor of Dartmouth College and other educational institutions, and the extracts from Dr. Smith's ledgers and lecture notes. Mrs. Smith has drawn a much clearer and fuller picture than had been done before of the setting of Nathan Smith's life, of his struggles and trials, of his indomitable courage and resourcefulness, of his marvelous capacity for work, of his professional and educational ideals and activities, and of his triumphs. We catch intimate glimpses of the active-minded lad upon the frontier, of the student at home and abroad getting, in spite of great difficulties, a good medical training, of the lover "transported with joy and expectation," of the devoted husband and father, solicitious for the education of his sons, of the busy physician and surgeon, "bandied about from one

[1] Introduction to the memorial volume The Life and Letters of Nathan Smith, M. B., M. D., by Emily A. Smith.
New Haven, 1914, Yale Univ., 201 p., 8°. (Introduction.)

part of the country to the other," treating fevers, couching for cataract, cutting for stone, excising tumors, and embarrassed most of the time, as is the way of doctors, from failure or inability to collect his fees, small as they were, of the founder of medicial schools and the professor, filling and filling well all the chairs in the medical curriculum, from all accounts a really great teacher, and withal deserving President Woolsey's characterization of him as "the most delightful, unselfish and kind-hearted man I ever knew, and we children all loved him."

Dr. Smith's letters to Shattuck remind one not a little of John Hunter's correspondence with his former pupil, Jenner. How suggestive of Hunter's many commissions imposed upon Jenner is the letter (on page 47 of this book) beginning, "I am continually troubling you about many things!" . . . . "If you have a man in Boston who makes thermometers, and if he can do it, I wish also to have an air thermometer constructed according to Henry's directions in his chapter on Caloric. I presume you can find that book in Boston, and the workman may follow that in his work." The repeated requests to send chemicals, apparatus, instruments and books afford some insight into Dr. Smith's scientific interests and activities, as does also the novel task assigned to two of his pupils to read through fifty-two volumes of historical works, recently added to his library, in order to cull out and index "everything relating to medicine or medical men."

The difference between the mental attitudes toward medical science of Nathan Smith and of his older contemporary, Benjamin Rush, is made clear in the letter to Dr. Shattuck when a student in Philadelphia. Rush, the greatest historical figure in American medicine, belonged essentially to the group of systematists of the eighteenth century. Dr. Smith writes: "Dr. Rush must be a very interesting lecturer. As to his classification of diseases I do not think it very material. However we may class diseases, we must study them in detail. . . . . As to the unity of disease, you know it is my opinion that we have in medical science of late generalized too much and that the progress of medicine has been checked by it. This mode of proceeding tends to substitute idleness for industry, and dogmatism for patient inquiry."

None of Nathan Smith's contemporaries in this country was possessed in larger measure of the true spirit and method of scientific inquiry. A very remarkable vision of the benefits that must accrue to medicine by the applications of chemistry and of the experimental method to the problems of disease is presented in the extract from one of his lectures on chemistry printed on page 79 of this book.

Nathan Smith was one of the earliest and best of the new generation of medical men who came to the front in the quarter of a century immediately

following the war of the Revolution and gave to American medicine a self-reliance, an adaptation to the needs of a rapidly expanding country, an activity and a productivity previously unknown. Only two medical schools, one in Philadelphia and one in New York, had been established in the decade preceding the Revolution; now new medical schools, societies, and journals were founded and the practice of medicine and of surgery was brought fully abreast of the times. While the most familiar names of this heroic period are of physicians and surgeons of the cities on or near the Atlantic seaboard, as John Warren, Samuel Bard, Wright Post, David Hosack, Benjamin Rush, Philip Syng Physick, David Ramsay, yet in many ways the most original, interesting and distinctively American are those of the frontier, as Ephriam McDowell, Benjamin W. Dudley and Daniel Drake. Dr. Nathan Smith had closer kinship with this latter group than with the former. In his early years the parts of Vermont and New Hampshire where he lived were scarcely less frontier settlements than were Kentucky and Ohio. Smith, like McDowell and Dudley, received an excellent medical training, enjoying the advantages of European study, but not the least valuable part of the training of these men was acquired during their youth in the woods and the fields under the primitive conditions of pioneer life, imparting that vigor, virility, keenness of observation, resourcefulness and fund of good sense which characterized them.

In his day Nathan Smith shared with John Warren a position of unexampled preeminence in the medical profession of New England, his activities extending over a wider territory and including all of that region except eastern Massachusetts and Rhode Island. He is a remarkable example of equal eminence in internal medicine and in surgery. Only a later generation could appreciate fully how original and great was the contribution to medicine which he made in his essay on "Typhus Fever," now a medical classic. Probably the first adequate appreciation by a competent authority of Dr. Smith's "Observations on the Pathology and Treatment of Necrosis" is that of the distinguished surgeon, Frederick Lange, in his paper on osteomyelitis in the "Festschrift" in honor of von Esmarch, published in 1893. Both of these famous essays are models of keen observation, accurate description, correct inference, expressed in clear and simple language and presenting admirable pictures of the conditions described.

Mrs. Smith has set forth fully the interesting circumstances of Nathan Smith's unprecedented activities connected with the establishment of four medical schools, those of Dartmouth, Yale, Bowdoin and the University of Vermont. The only one of these schools which he actually initiated was that of Dartmouth, where for twelve years he taught, with only occasional and slight assistance, all of the subjects then included in the medical curric-

ulum, and we know that he taught them well. Few teachers have ever been held in greater esteem and affection by pupils than was Dr. Smith. One cannot restrain a feeling of regret, although sympathizing with the enlightened decision necessitated by the changed conditions of medical education, that the Dartmouth Medical School, with its long and honorable history, is to discontinue the last two years of the course after the present session.

That Dr. Smith did not believe in the unnecessary multiplication of medical schools is apparent from the statement in his letter to Dr. Shattuck of April 18, 1823 (on page 122): "I think the four schools which I have been concerned in bringing forward, in addition to Harvard, will be as much as New England will bear, and I think there will not be too many. Every state should have one medical school and no more." It would have been well for medical education in this country if this standard had been maintained, and well too if his example had been followed of establishing such schools only in association with colleges or universities.

Coming to New Haven in 1813 in the fullness of his powers, Nathan Smith was by far the most distinguished member of the first faculty of the Yale Medical School and the one most active in its organization and development. Here, too, was the scene of his most productive activities, of his widest influence and greatest usefulness. If provided with adequate resources, the Yale Medical School, favorably located in connection with a great university, is in a position to enter upon the second century of its existence with a well-founded expectation of renown and usefulness surpassing even the high hopes of Nathan Smith, under whom it had attained a large measure of prosperity.

It was related that the first President Dwight was accustomed to give a brief sketch of the events of Nathan Smith's life to the senior class of Yale College "in order to awaken their ambition and to encourage them in surmounting difficulties." It was indeed a life full of useful lessons, and many will be grateful to Mrs. Smith for this memorial volume, which will help to extend and perpetuate the fame of a great physician, teacher and builder, whose name stands high in the medical annals of this country. Several of the descendants of Nathan Smith became distinguished in medicine and an interest attaches to the short biographical notices of other members of this remarkable family of physicians.

SILAS WEIR MITCHELL

PHYSICIAN AND MAN OF SCIENCE[1]

Deep as is our sense of loss upon the passing of one who has been these many years the foremost figure in American medicine, the dominant feeling on this occasion must be one of exultation over a life of well nigh fourscore years and five. Marvellously rich in varied achievement in medicine and letters, beneficent and enduring in influence, and closing with mental vigor and activity unimpaired until that brief last attack of the disease which has been called "the friend of the aged."

It has fallen to me on this occasion to pay tribute to Dr. Mitchell as physician and man of science—the larger and more important side of his life and work. I esteem this opportunity a precious privilege, imperfectly as I shall be able to meet its obligations, for his friendship has been to me, as to many others, a dear possession and strong influence.

Fortunate and necessary as it is that different speakers should present different aspects of Mitchell's life and work, there must enter into the picture drawn by each the whole man. No estimate of his medical work can leave out of account the remarkable personality: the traits of mind, of heart, of hand; the genius for friendship; the power to stimulate and inspire others; the setting of time, environment, and opportunity. His literary works have much of circumstance, color, insight, and knowledge which came to him as a physician, and not a little of his medical writing has the charm and power of literature. We, of his profession, should not be willing to relinquish all claim to "Dr. North and His Friends" or to "The Autobiography of a Quack" and the "Case of George Dedlow," or to some of the poems, as "The Birth and Death of Pain," "A Doctor's Century," "The Physician," and others read on medical occasions. Many of his novels contain descriptions of doctors, patients, epidemics, and historical events which are of distinct medical interest and value.

Weir Mitchell's medical education was such as was customary at the time and in no way remarkable. Leaving, in 1848, on account of illness the Uni-

[1] An address delivered at a joint meeting of the College of Physicians of Philadelphia, the American Philosophical Society, the University of Pennsylvania, the Library Company of Philadelphia, the Jefferson Medical College and the Academy of Natural Sciences, in memory of Silas Weir Mitchell, Philadelphia, March 31, 1914.

S. Weir Mitchell, M. D., LL. D., F. R. S., 1829-1914. Phila., 1914, 99-127.

versity of Pennsylvania in the senior year of his college course, he received, after two years of study at the Jefferson Medical College, his degree of doctor of medicine in 1850, his graduating thesis being on "The Intestinal Gases." One of the two hundred and eleven members of his class was his friend and coworker, George R. Morehouse. The members of the faculty at that time were among the leading men of the profession, whose names are still remembered: John K. Mitchell, Dunglison, Houston, Pancoast, Mütter, Charles D. Meigs, and Franklin Bache. Such teachers must have done much to compensate for the defects in the system of medical education then existing in this country, and they help to explain why the results were so much better than the system. Young Mitchell's work in analytical chemistry in the spring and summer for two years and a few months in Brown's drug store must have afforded valuable training in accuracy.

It is indeed startling to find in some rough autobiographical notes left by Weir Mitchell, for extracts from which I am indebted to his son, Dr. John K. Mitchell, Jr., the statement of the father, Dr. John K. Mitchell: "You are wanting in nearly all the qualities that go to make a success in medicine. You have brains enough, but no industry." Then follows the comment: "He was correct enough. I developed late."

Another interesting note reads: "Surgery, which was my father's desire for me, was horrible to me. I fainted so often at operations that I began to despair—but my assisting at the surgical clinics I overcame by degrees my horror of blood and pain." Mitchell's experience as a student in this regard is not uncommon, and affords no more indication as to fitness for the profession of physician or surgeon than does the lack of susceptibility to such sensations.

The year of medical study in Paris in 1851-1852, although much interrupted by illness, was a broadening experience. Here he took courses designed for surgical training, evidently keeping in view his father's desire, but he adds in the autobiographical notes: "I liked better the lessons of Bernard in physiology and of Robin in microscopy." To both of these great teachers and investigators Mitchell has expressed his indebtedness. Of the former he says in his memoir of Dalton: "Bernard strongly influenced the men who sought his courses, and I for one, like Dalton, must gladly acknowledge the educative power of this sturdy genius."

The greatest educative influence, however, upon Weir Mitchell was unquestionably that of his distinguished father, one of the most remarkable and original physicians in the medical history of this country. Of him the son writes in the notes to which I have referred: "My father was the best physician I ever knew. He never failed in resource, and always had something in reserve. Also for carefulness, watchful attention, and swift deci-

sions he has no equal in my memory." There are remarkable similarities between father and son. Dr. John K. Mitchell, the elder, was a handsome man of social gifts, an acute observer and reasoner, an experimentalist, broadly interested in natural science, endowed with the scientific imagination, a distinguished physician and teacher, who also wrote verse. He said, as well as Henle, all that could at the time be said in support of the germ theory of malarial and other fevers, and anticipated modern theories of immunity. The son has rescued from oblivion his father's account of the spinal arthropathies, clouded, though it is, by some unfortunate speculations and generalizations.

The decade following Weir Mitchell's return from Europe was devoted to a growing, but not too engrossing general practice, which left time for those experimental investigations in physiology, pharmacology, and toxicology which laid the foundations of his fame in experimental science. He was the first conspicuous example in this country of a medical reputation and career based upon and determined largely by the devotion of the early professional years to the kind of work which we now call laboratory work, although there were no medical laboratories then in America.

In his address before the Medical and Chirurgical Faculty of Maryland in 1877, Mitchell, while speaking of the value of such work in the training of the physician, evidently draws from his own experience when he says: "You ask me where, among medical men, we are to find those who have leisure for the work of the laboratory and for its side of scientific therapeutics. And to this I answer, there are long years of but partial occupation in the early life of every physician in which he can find ample time for such employment. Will it help or hurt him in his after life? The day has gone when a man may dare to be just only a prescribing doctor. It has gone, I trust, forever. Many years ago the late Prof. Samuel Jackson said to me most earnestly, 'If you want to practise medicine, do not venture to be an experimental physiologist. It will ruin you.' I did not take his advice; and I dare now to counsel any young and able man among you that to spend a few years in such work is not only to give himself the best of intellectual training, but is also one of the best means of advancing himself and fortifying his position when by degrees he becomes absorbed in clinical pursuits and daily practice." These words are as true today as when they were spoken. At the time when Mitchell began his professional career the Academy of Natural Sciences, instituted in 1812, was the most active center of scientific work in Philadelphia. He was elected a member of this body in September, 1853, and two months later he read before the academy his second published paper entitled, "On the Influence of Some States of Respiration upon the Pulse," which was published in abstract in the "Proceedings" of the academy and in full the

following year in "The American Journal of Medical Sciences." As early as January, 1855, he finds his characteristic place as a member of the library committee.

Up to this time the contributions to the academy had been mainly in the fields of descriptive and systematic zoology, botany, geology, and anthropology, but there now appeared a small group of young investigators interested in the experimental biological sciences. They established the short-lived Philadelphia Biological Society, which served its main purpose in leading the more conservative members to agree to the creation of a Biological Department of the Academy in March, 1858. Mitchell with Leidy, Hammond, Woodward, Morehouse, Hays, Hartshorne, Atlee, J. A. Meigs, Morris and others were among the petitioners for the organization of this department. Leidy was the first director, William A. Hammond the vice-director, and Mitchell was on the physiological committee, the following year succeeding to the vice-directorship, Leidy remaining in office.

At the first meeting, in April, 1858, of the Biological Department, Mitchell presented the first paper on "Blood Crystals of the Sturgeon," with colored plates, and early the following year he again reported on blood crystals. It is interesting to recall how this early interest was renewed in recent years by the great work of Reichert on the crystallography of haemoglobin, which Mitchell did so much to further.

In 1854, and for several years following, Mitchell was lecturer upon physiology in the Philadelphia Association for Medical Instruction, an organization for extramural teaching of a type for which the city of Philadelphia was once famous.

In 1857, Mitchell was one of the founders of the Pathological Society, to which he presented the first specimen, of which he reminds us in his toast to the surviving members at the dinner commemorating the fiftieth anniversary of the society.

If it be true, as he tells us, that he was late in developing—and I can scarcely credit it—he had by his twenty-eighth year surely and fully arrived. One would like a pen picture from a competent contemporary of this period, but the record suffices to show the ardor, the industry, the fertility, the truly scientific spirit of the student of nature—qualities which remain undimmed until the end.

Preceding the turning point in Mitchell's career, in 1863, when he assumed medical charge of an army hospital for nervous diseases, he had published not less than twenty-two medical papers and reports, none of them clinical and nearly all in the domains of physiology, pharmacology, and toxicology. The first was in 1852 on the "Generation of Uric Acid"; all but three fell within the years 1858 to 1863 inclusive. The most important of

these early publications, three being in association with Hammond and one with Morehouse, were concerned with the comparative anatomy and physiology of the respiratory and circulatory organs, and the toxicology of arrow and ordeal poisons and of snake venom. The "Report on the Progress of Physiology and Anatomy," published in 1858,[2] is of great value for the student of the history of physiology in this country.

We encounter at this early period Mitchell's singular faculty of observing and recording certain curious phenomena, some still awaiting explanation, such as the production of cataract in the frog by the injection of cane sugar,[3] the effect of mechanical stimulation of muscle, the nerve chiasm on the larynx of turtles, and later the insusceptibility of pigeons to morphine, and certain effects of freezing parts of the central nervous system.

I find also as early as 1858 an interesting and perhaps the first recorded example of the suggestiveness which was such a remarkable characteristic of Mitchell's mind. In November of that year he submitted to the Biological Department of the Academy of Natural Sciences a proposal for collective investigation of the changes undergone by the white race in America and outlined a tentative plan to be followed. The proposal was favorably received and Mitchell was authorized to create a committee for the purpose. I cannot find that this interesting line of investigation, which in recent years especially has awakened renewed interest, was undertaken by Mitchell, but he has repeatedly touched upon the subject in his writings.

The most valuable of Mitchell's publications of the period we are now considering is his monograph of one hundred and fifty pages upon the venom of the rattlesnake, published in 1860 in the "Smithsonian Contributions." Concerning this he says in the catalogue of his works printed in 1894: "This quarto with its many drawings was the result of four years of such small leisure as I could spare amidst the cares of constantly increasing practice. The story of the perils and anxieties of this research, embarrassed by want of help and by its great cost, is untold in its pages. It was the parent of renewed Indian researches. So far as the habits, anatomy, and physiology of serpents are concerned, no one has bettered this work. An enormous addition was made in it to venom toxicology; . . . . many questions of antidotes were set at rest. It contained, of course, errors, now corrected in the later researches of its author, and quite recently of the author and Prof. Reichert."

The investigation of the venom of serpents and its effects engaged the attention of Mitchell off and on for half a century, and indeed had interested

[2] American Medico-Chirurgical Review, 1858, II, 105.

[3] Bernard a few months before had made the same observation, but this was then unknown to Mitchell.

his father, who transmitted to his son dried rattlesnake venom, some of which may still be in existence. Of the many valuable results of this prolonged experimental study, embodied in twelve papers and monographs, an epochal one is the first demonstration by Mitchell and Reichert, in 1883, of the so-called toxic albumins, to which class belong not only the snake venoms but also certain plant and especially bacterial poisons. The later classical researches of Flexner and Noguchi, culminating in Noguchi's fine volume on "Snake Venoms," owe their inception to the inspiration and support of Mitchell, aided by grants from the Carnegie Institution. I also owe to the suggestion of Mitchell a small research undertaken in my laboratory by Major Ewing, which led to the discovery of the power of venom to annul the bactericidal power of the blood, thereby explaining the quick onset of putrefaction following death from rattlesnake venom.

Mitchell's interest and activity in experimental science did not cease after he became identified with neurology. After 1863 he published at least ten physiological and about twenty-five pharmacological and toxicological papers. In this later period his physiological researches were mainly in the field of neurophysiology, among the more important contributions being those on the physiology of the cerebellum, in which he developed a view which was practically that advocated, much later, by Luciani, on cutaneous nerve supply, thus opening a field so successfully cultivated in recent years by Head and others, and together with Lewis on tendon jerk and muscle jerk in a series of elaborate researches which have been the starting point for many interesting physiological and clinical studies. In Mitchell's purely neurological writings are to be found many observations, facts, and conclusions which are contributions to neurophysiology as well as to neuropathology, such as the influence of nerve lesions on nutrition, on local temperatures, on the various senses; the study of the effects of freezing his own ulnar nerve; the observation of crossed paralysis of the thermal sense without other sensory loss, and his views concerning fatigue and exhaustion of nerve cells as the result of peripheral irritation.

I have said these few words concerning the later physiological studies of Mitchell in order to indicate the important position which he holds among the physiologists of this country.

As the result of an accident, fortunate for physiological science, it fell to the lot of Beaumont, beginning in 1825, to make a series of experiments upon gastric digestion which constitute the greatest contribution which America has made to physiology. Dunglison was an admirable teacher and author, but not an experimenter. The first systematic and fruitful cultivators of experimental physiology in this country were Mitchell and Dalton, whose work was practically contemporaneous up to the death of the latter

in 1889. My colleague, Dr. Howell, a most competent judge, in an unpublished paper upon the history of American physiology, which he has permitted me to read, states that in the period before the establishment of laboratories by Bowditch and by Newell Martin, in the seventies, "probably the most significant name from the standpoint of physiological investigation is that of S. Weir Mitchell."

The creation of the American Physiological Society in 1887, which has greatly advanced this science in this country, was first suggested by Mitchell, who with Bowditch and Newell Martin signed the call for the preliminary meeting. Among the many debts which physiology owes to Weir Mitchell should not be forgotten his readiness, whenever needed, to come to the defense of the experimental method of research upon which depends the advancement of both the science and the art of medicine.

In 1863, during the Civil War, came the great opportunity which determined Mitchell's subsequent career as a neurologist. For the first time in the history of warfare a number of military hospitals or wards were established by Surgeon-General Hammond for the study and treatment of special diseases and injuries incident to war. Mitchell and Morehouse, then acting assistant-surgeons, were placed in medical charge of the hospital for nervous diseases and injuries, located first in Christian Street and later in Turner's Lane, Philadelphia. It was Mitchell who suggested the establishment of this hospital, and secured the appointment as junior assistant of William W. Keen, then assistant-surgeon, and his most efficient, devoted, and zealous coworker.

The inspiring story of those days has been vividly told in this hall by Mitchell and Keen, and I shall not attempt to rehearse it. One is reminded of the almost feverish activities of the young Bichat in the Hotel Dieu by the work, until late hours of the night, of these three ardent investigators, minutely observing and recording in thousands of pages of notes phenomena often both new and interesting, analyzing, conferring, apportioning to each his share in working up the results. The opportunity was unique, and they seized it with full realization and utilization of its possibilities. "I think," said Dr. Mitchell a few years ago in his "toast" to members of the Pathological Society, "we used well the terrible opportunities of those bloody sixties, and if you are today as enthusiastic, as industrious, and as fertile, you are to be congratulated."

Beginning with Circular No. 6, on "Reflex Paralysis," issued from the Surgeon-General's Office in March, 1864, there followed a series of joint publications, the most important being the memorable volume on "Gunshot Wounds and Other Injuries of Nerves," (1864). That on "Malingering" (1865), and the experimental part of the paper on the "Antagonism of

Morphia and Atropia," both interesting and valuable contributions, were mainly the work of Keen.

In 1872 Mitchell gathered together his observations, experiments, and conclusions in the largest and, in my judgment, the most significant and important of all his medical writings, the book entitled "Injuries of Nerves and Their Consequences," to which a valuable addition was made by his son, Dr. John K. Mitchell, in a volume published in 1895 containing the subsequent histories of the surviving patients with additional illustrative cases. The study and description of peripheral nerve phenomena, especially those resulting from injury, constitute the largest, most original, distinctive, and important contribution of Weir Mitchell to neurology, and in this narrower field his work is comparable to that of Duchenne and of Charcot upon diseases of the spinal cord.

The lean years and the period of hard struggle were now over. After the war Mitchell rapidly became and afterward remained the leading neurologist of America, and one of the most distinguished in the world. In 1870 he was instrumental in establishing the Infirmary for Nervous Diseases as a part of the Orthopedic Hospital, an institution which he has made famous. Here he found ample material for clinical study, and here for over forty years he taught and worked and created a school of able investigators and clinicians who have brought renown to American medicine.

The mere enumeration of Mitchell's discoveries and original observations in neurology—such as of postparalytic chorea; erythro-melalgia, the reflex disorders due to eye-strain, in which he was aided by William Thomson; the unilateral hard oedema of hysterical hemiplegia; the relation of pain to weather, and others—affords no adequate conception of the extent and value of his work in this field. We shall all agree with Dr. Charles K. Mills, who with competent hand has set forth recently a brief summary and appreciation, that a "thorough and elaborate study of his neurological contributions is due to his memory." This will be no easy task and will require much time, labor, and expert knowledge, so prolific was Mitchell's pen and so suggestive, at times almost elusive, are thoughts and observations found often in a few sentences, sometimes a single one.

I have collected two hundred and forty-six references to books, papers, and reports by Mitchell from the "Index Medicus," the "Index Catalogue," medical journals, and his printed catalogue, which is incomplete even for the period covered, and I have no doubt the list exceeds two hundred and fifty. I classify one hundred and nineteen of these as neurological and fifty-two as physiological, pharmacological, and toxicological, the remainder being addresses and historical biographical, pathological, and miscellaneous medical papers.

One of Mitchell's fascinating characteristics was his interest in and study of certain curious, out-of-the-way phenomena, often of as much psychological as neurological interest. His descriptions of ailurophobia, or cat-fear, of disorders of sleep, and of certain peculiar functional neurotic disorders may be cited as examples.

With what felicity of style, with what magic touch, with what lucid and sharp delineation did Mitchell often adorn his medical writings! Definitions of medical terms are not often set forth in such words as these: "As we are falling asleep the senses fall from guard in orderly and well known succession—this interval I desire to label the *proedormitium*. When we begin to awaken, and the drowsied sentinels again resume their posts, there is a changeful time, during which the mind gradually regains possession of its powers—this interval I may call, in like fashion, the *postdormitium*." Nor does one often meet such a description of a sensory hallucination as this: "Nearly every man who loses a limb carries about with him a constant or inconstant phantom of the missing member, a sensory ghost of that much of himself, and sometimes a most inconvenient presence, faintly felt at times, but ready to be called up to his perception by a blow, a touch, or a change of wind." Hundreds of similar happy phrases and descriptions may be found throughout his medical writings and addresses.

The admirably descriptive titles which Mitchell gave to his articles may appear to some a small matter, but it will not seem so to the cataloguer and the searcher of medical literature. How grateful to such a searcher is this one which only too often would have appeared under some such rubic as "a rare case": "Reversals of habitual motions; backward pronunciation of words; lip whispering of the insane; sudden failures of volition; repetition impulses"!

As Dr. Mills remarks, "Mitchell is one of the few neurologists to whom well-deserved fame has come because of his contributions to therapeutics." He is doubtless best known to the lay public, as well as to a large part of the profession, by the introduction of that method of treatment which goes by his name, and consists in the systematic employment of a number of agencies, chiefly rest, seclusion, full feeding, massage, and electricity. When one considers the brilliant success of this treatment in appropriate cases in the hands of Mitchell and others, the immense literature upon the subject, the direct and indirect bearings and implications of the method, and the stimulus which it has given to the study and relief of a large and difficult class of functional neurotic disorders, I believe it safe to say that the introduction of this Weir Mitchell treatment constitutes one of the great advances in therapeutics of modern times, and this I say with knowledge of diverging opinions and criticisms.

There are many aspects of the professional life and work of this extraordinarily able and versatile man, other than the physiological and neurological, concerning which I should like to speak, and had expected to speak, did time permit, such as his valuable contributions to medical history, particularly in the remarkable address on the early history of instrumental precision in medicine, the recollections of the Civil War, and, above all, his fascinating and even surprising additions to our knowledge of Harvey, whom he admired above all men of medicine; his public addresses, unmatched for style, charm, and interest; his instructive talks to nurses; his biographical memoirs, like that of Dalton, to which I have referred; the delightful popular lectures, articles, and books, such as "Wear and Tear," or "Hints for the Overworked," which has gone through many editions since its first appearance in 1873, and the later "Doctor and Patient"; the researches of others stimulated and inspired by him, whereby he greatly multiplied his services to science and medicine; the many honors and recognitions which came to him here and abroad, and distinguished Mitchell above all physicians of America; his great services to medical education as a member of the Board of Trustees of the University of Pennsylvania, to whose great growth and prosperity he contributed so largely, and other institutions which he served in a similar capacity might also be included. It is needless in this hall, which bears his name, and before this audience for me to dwell upon his inestimable services to the College of Physicians of Philadelphia, of which he became a Fellow in 1856, and which grew to be one of the dearest interests of his life. Here his name is perpetuated and here it will ever be treasured as the chief ornament and greatest benefactor of the college.

Representing officially on this occasion the National Academy of Sciences, I bring our tribute to the memory of the oldest member when he died, his election, due to his contributions to experimental science, dating from 1865. Through all these years he had been a regular attendant and frequent contributor at the meetings, his presence here, as elsewhere, always bringing cheer and inspiration. He will be sadly missed from our meetings.

At the fiftieth anniversary dinner of the academy last spring, Mitchell spoke delightfully of the past history of the academy, his reminiscences of Joseph Henry being particularly interesting. At the semi-annual meeting in Baltimore, last November, Mitchell read the biographical memoir of his most intimate friend in the profession, Dr. John S. Billings. This memoir of a friend to whom, for over half a century, he had been devotedly attached, is significant as the last contribution of Weir Mitchell to medical literature.

I am commissioned to speak also in behalf of the Carnegie Institution of Washington, of which Mitchell was designated a trustee by the founder in 1902, and in the development of which he was deeply interested. From the

beginning he was a member of the executive committee, and a most diligent and active one. He was especially effective in the furtherance of the biological work undertaken by the Institution, and scarcely less so in other directions. The institution owes a large debt to the wise counsel and suggestive mind of Weir Mitchell.

However the verdict of history may modify contemporary judgments of the achievements of men, it cannot change the place which Dr. Mitchell holds in our affection and esteem. He was a great physician; our leader, endeared, admired; our friend and counselor, generous, wise, inspiring; a man of singular graces and accomplishments, active in advancing knowledge and in good works, a poet and man of letters, a sweetener of life to both sick and well. Happy such a life and happy the memories thereof which we shall ever cherish! As he said of Harvey, we may say of him—Weir Mitchell represented all that is best in the physician and the gentleman.

SILAS WEIR MITCHELL[1]

Silas Weir Mitchell, eminent as neurologist, physiologist, and man of letters, was born in Philadelphia, February 15, 1829, and died after a brief illness from pneumonia at his home in the same city where his life was spent, on January 4, 1915. His father, Dr. John Kearsley Mitchell, was likewise a distinguished physician of Philadelphia. Obliged to leave the University of Pennsylvania in the senior year of his arts course on account of ill health, he later entered on the study of medicine at the Jefferson Medical College, where his father was professor, and received his medical degree in 1850. He then spent a year in medical study in Paris, where he came under the influence of Claude Bernard and Robin. Returning to Philadelphia he began medical practice, but this was not so engrossing as to withdraw him from scientific investigation. Until the year 1863 Mitchell's chief interest and all of his published works were in the domains of physiology, pharmacology, and toxicology, which he pursued mainly by the experimental method. At this period Mitchell was active in the Academy of Natural Sciences of Philadelphia and with Leidy, Hammond, and Woodward was instrumental in establishing the Biological Department of the Academy. In 1857 he was one of the founders of the Pathological Society of Philadelphia. During the first 12 years of his professional life Mitchell published not less than 22 papers, none of these being clinical and nearly all being within the experimental medical sciences. The most valuable of his publications of this period is his monograph of 150 pages upon the venom of the rattlesnake, which appeared in 1860 in the Smithsonian Contributions. This subject engaged attention off and on for the next half century, and indeed had interested his father. An epochal result of this prolonged experimental study was the first demonstration by Mitchell and Reichert in 1883 of the so-called toxic albumins, to which class belong not only the snake venoms, but the bacterial and certain other plant poisons.

Mitchell's reputation as a physiologist was established before he devoted himself to neurology, and this physiological interest continued throughout his life, his later contributions to physiology being mainly in neurophysiology. Although he made no physiological discovery equaling in importance that of Beaumont on gastric digestion in 1825, his name and that of his friend and contemporary, Dalton, are the most significant from the standpoint of systematic, productive investigation in American physiology before the laboratory era introduced by Bowditch and Newell Martin in the seven-

[1] Prepared for the biographical notes of the Report of the National Academy of Sciences.

Rep. Nat. Acad. Sc., Wash. (1914), 1915, 40-41.

ties. He was always ready to come whenever needed to the defense of the experimental method of research upon which depends the advancement of medical science and art.

In 1863, during the Civil War, Mitchell, then acting assistant surgeon, was placed, together with Morehouse, in medical charge of a military hospital for nervous diseases and injuries in Philadelphia. This furnished him a unique opportunity, which he utilized to the utmost, and this determined his future career as a neurologist. The most important first fruits of the observations and studies there made by Mitchell, with his associates Morehouse and Keen, were the monograph on "Reflex Paralysis" and the memorable volume on "Gunshot Wounds and other Injuries of Nerves," both published in 1864. In 1872 Mitchell gathered together his observations and experiments in perhaps the most important of his medical writings—the book entitled "Injuries of Nerves and their Consequences." This work constituted the most important contribution which had been made to the subject of peripheral nerve phenomena in disease and resulting from injury.

After the war Mitchell rapidly became and remained the leading neurologist of America and one of the most distinguished in the world.

Mitchell's neurological contributions were many and important. He published not fewer than 250 medical papers and books. He was peculiarly interested in certain curious, out-of-the-way phenomena, such as cat-fear, disorders of sleep, and functional disorders. His name is probably most familiar to the public and the medical profession as the originator of the method of treatment which goes by his name and consists in the employment of rest, seclusion, full feeding, massage and electricity.

Many of Mitchell's scientific and medical papers are characterized by a felicity of style not often found in such publications. He is a remarkable example of distinction not only as a physician and man of science, but also a poet and writer of novels and short stories. He did not indulge his literary bent until after his professional reputation was established. After 1882 there followed his well-known novels: "Hugh Wynne," "The Adventures of François," "The Red City," "Westways," and many others, which have established his reputation in the world of letters.

Mitchell possessed an extraordinarily suggestive mind, and many are the researches of others stimulated and inspired by him.

He received many honors and recognitions in this country and abroad. His election to the National Academy of Sciences dates from 1865 and was due to his work in experimental science rather than to that in clinical medicine. His presence was always a source of cheer and inspiration. He spoke of the past history of the academy at the fiftieth anniversary dinner, and his last contribution was the biographical sketch of his intimate friend, Dr. John S. Billings.

CHARLES SEDGWICK MINOT [1]

Charles Sedgwick Minot was born in Boston, Mass., December 23, 1852, and died at his home near there after a painful illness of several months' duration on November 19, 1914.

After graduating as bachelor of science from the Massachusetts Institute of Technology in 1872, Minot pursued graduate studies in physiology, histology, embryology, and zoology, in the Harvard Medical School under Bowditch, in the Universities of Leipzig under Ludwig and Leuckart, of Paris under Ranvier, and of Würzburg under Kölliker and Semper. He returned to America with a mastery of microscopical technique and a broad foundation of knowledge in the biological sciences, to which he had already begun to make contributions. His earliest studies were in entomology. Under Bowditch and Ludwig he was trained as a physiologist and conducted valuable experiments upon the physiology of muscle, for which he received in 1878 the degree of doctor of science from Harvard University. He was, however, more attracted to morphological studies, and after his appointment in 1880 as lecturer on embryology, to which histology was added, in the Harvard Medical School, his main scientific work lay in these fields. After filling successively the positions of lecturer, instructor, and assistant professor, he became professor of these subjects in 1892 and since 1905 he held the professorship of comparative anatomy and the directorship of the anatomical laboratories in the Harvard Medical School.

Minot devised two widely used forms of automatic microtomes. His contributions to mammalian embryology were numerous and important and are embodied in many papers and memoirs and in his great work on "Human Embryology," published in 1892, his "Bibliography of Vertebrate Embryology" (1893), and his "Laboratory Text-book of Embryology" (1903), the third edition of which he left nearly ready for the printer at the time of his death.

Minot developed a laboratory admirably equipped for teaching and research. Here he gathered a wonderful collection of over 1900 embryos of various animals, cut into sections, arranged, and catalogued so as to constitute a vast material for the study of vertebrate embryology. He substituted for the chick embryo largely that of the pig and other mammals for teaching embryology. His name is particularly associated with the advancement of knowledge concerning the placenta and the embryonic membranes.

[1] Prepared for the biographical notes of the Report of the National Academy of Sciences.

Rep. Nat. Acad. Sc., Wash. (1914), 1915, 47-49.

Of the more purely histological studies perhaps the most important is that published in 1900 "On a Hitherto Unrecognized Form of Blood Circulation without Capillaries," in which he described a lacunar system of vessels to which he gave the name "sinusoids."

The breadth of biological interest with which Minot approached the investigation of structure was especially manifested in his studies of growth, the results of which are presented in his thoughtful and suggestive work entitled, "Age, Growth, and Death," published in 1908. Here he seeks to establish the cytological causes of senescence, which he finds in the increase and differentiation of cytoplasm as related to nucleoplasm.

Endowed with intellectual gifts of a high order, with broad and exact scientific training, with vision and insight, with rare powers of public speech, Minot was one of the strong and stimulating influences in the organization and development of the biological sciences in America during the past 30 years. He was especially active in promoting the interests of the Society of Naturalists, of the American Association for the Advancement of Science, of which he was president in 1900, of the Boston Society of Natural History, of which he was president from 1897, and of the American Association of Anatomists. He was elected a member of the National Academy of Sciences in 1897 and was active in the work of the academy. His administration of the Elizabeth Thompson Fund is an example of the possibilities of usefulness of even relatively small grants in the aid of research.

Many of Minot's admirable presidential and other general addresses, including those delivered as Harvard Exchange professor to the Universities of Berlin and of Jena in 1912-13, have been published in two German works entitled "Die Methode der Wissenschaft," 1913, and "Moderne Probleme der Biologie," 1913, also translated into English. Some indication of their scope may be furnished by such titles as "The Work of the Naturalist in the World," "Knowledge and Practice," "The Embryological Basis of Pathology," "Ideals of Medical Education," "The Problem of Consciousness in its Biological Aspects."

Minot was a member of many American and foreign scientific societies, Sc. D. of Oxford, and LL. D. of Yale, Toronto, and St. Andrew's Universities.

The significance of Minot's work is not to be found solely, or even chiefly, in the narrower fields of anatomical inquiry which he cultivated so successfully, but even more is to be sought in his services in spreading the spirit of science, in advancing scientific research, and in endeavoring to direct educational and scientific institutions and societies toward these great ends.

REMARKS AT DINNER IN HONOR OF WILLIAM T. COUNCILMAN[1]

Dr. Councilman, Mr. Toastmaster, Gentlemen.—I wish I could feel that the tribute to our Councilman accrued also to me in the measure which your applause might possibly suggest. The truth is that when I came to Baltimore in 1885 (I was called in 1884) I found pathology already represented here by Dr. Councilman in such a way that it might really be a surprise to anyone as to why they should have looked elsewhere for the incumbent of the chair.

When I arrived in 1885, I found here a man who had already made valuable contributions to pathology. Dr. Thayer has spoken of the restraint which characterizes his utterances. I found that was already indicated in the title of his earliest publication: "Specimen showing congenital smallness of the right kidney, with enormous compensating hypertrophy of the left kidney."

There are some here, not many, who must look back to those early days, even before the hospital started, with feelings of great delight. They were simple days—the beginnings of things. The little group of men gathered here then comprised among others Councilman, Mall, Meade Bolton, Booker, Nuttall, Thomas, Wright, Abbott, Williams, Johnson and I daresay others who are here tonight. It was an enthusiastic group, but the man who really fired our enthusiasm with that fiery zeal which characterizes his inner disposition as well as his countenance was there from the start. He was really the life of that little group.

At that time he was pathologist to nearly all the medical institutions in Baltimore. We had no post mortem material except from the outside. He purchased a tricycle and his experiences were many, such as on hot days coming in from that little children's hospital on Franklin Street and from Bay View, with occasional accidents which even got into the newspapers, as when the streets were more or less littered with escaping specimens.

The hospital was building. One of my chief occupations, after having mastered the complicated system of heating and ventilation, was to serve as a guide to many visitors. Councilman consistently refused to learn how the hospital was heated and ventilated and declined to show anybody over those miles and miles of corridors and those ladders to be climbed. It has been

[1] Report of remarks made at a dinner given in honor of William T. Councilman, Baltimore, May 13, 1915.

Not previously published.

many years since I served in that capacity. Councilman was, however, tremendously absorbed in picking out the room he was going to occupy in the hospital. He would take me from the top to the bottom of the administration building, even before the stairs were in, to get my opinion as to the relative advantages of this or that corner room. He also practised on his tricycle through the corridors.

I think there were some advantages perhaps in the fact that the pathological building was constructed and occupied before the hospital was opened. It did create a certain atmosphere and there was a group of active young investigators. This was an advantage to the hospital; and it was also an advantage, I think, that the hospital was opened before the medical school.

The association with Councilman is a matter to me so intimate and one of such a personal character that these memories are very dear to me. It is hardly necessary to say that he was my mentor, and when he left, I felt as if my right hand had been taken off. It did not seem at that time, as if it would ever be possible to fill his place. He was a very inspiring teacher, but there was one quality which in a measure disturbed me for a while. Dr. Councilman has probably never known that I am responsible for his becoming an editor of a medical dictionary. I had not then become so accustomed to the congenitally bad speller as I have since then, and the embarrassment of strangers visiting the museum occasionally and looking at the labels on the specimens was so great, I thought it would do Councilman good if I threw in his way, the opportunity of serving as the editor of a medical dictionary. I doubt if many here know that he worked hard on the spelling and derivation of medical terms, not only in English, but in Latin, French, German, and Italian, in that famous medical dictionary with which his name will always be associated.

This is not an occasion in the midst of Councilman's career to estimate the significance and value of his work in pathology. He has been a great influence. His work began really in a pioneer period. His first publication was in 1880 and I think one which received the prize of the Baltimore Academy of Medicine. Beginning at the early period until today, he has stood for the value of pathology in its broadest sense, both anatomical and experimental, to our understanding of disease and the adequate training of medical students and physicians. His work has been important. His studies of morbid conditions have been characterized by thoroughness and have resulted in a very marked advance in our knowledge. I need cite merely as examples such masterly investigations as those on dysentery, cerebrospinal meningitis and smallpox.

When I went abroad, I came in contact especially with Celli who had studied with Marchiafava the malarial parasite discovered shortly before by Laveran. At the time the medical world was skeptical. I received while in Munich a letter from Councilman relating his experiences on malaria at Bay View, which I showed to Celli, who at that time was depressed by the fact that no one really considered there was anything in his observations. I am quite sure that Councilman's name is one which is to be connected, together with those of Celli and Marchiafava in the early confirmation of Laveran's discovery, for without knowledge of the previous and almost coincident observations he noted the bodies now recognized as parasitic.

This occasion is delightful in its bringing here a group of men with whom we were associated in the early days and whose presence Councilman must appreciate highly. Councilman, you know that this occasion is one which affords us the keenest delight. It is to us a source of the greatest pleasure to be able to indicate to you in this way our sentiments of affection and of admiration for you. Although you may suffer at the moment with what may be in store for you, I am sure you will look back eventually upon this manifestation of our pleasure in showing our tribute to you, with a great measure of satisfaction.

BEGINNINGS OF MEDICINE IN THE MIDDLE WEST[1]

I can only add a word to what Dr. Garrison has said in appreciation of Dr. Juettner's coming here and giving us this very interesting sketch of the physicians who built up medicine in the Middle West. Of course it is very difficult for us to have a standard of measurement in our estimates of physicians of that period. It is well worth while of course, to rescue the local annals of medicine in any part of the country. The interest in the names, however, is rather antiquarian and can hardly make a wide appeal. Even when we estimate the achievements of men in our own country, we have to compare them with their contemporaries elsewhere; and when we attempt to place them in any rank in the world's history of medicine with their contemporaries, that is an entirely different standard. When we consider who were the contemporaries in the first third of the nineteenth century of these names that we call, from our American point of view, our heroes, of course they play a pretty small part in the universal history of medicine. They were the contemporaries of Astley Cooper, Bichat, Laennec, Rokitansky, etc., and, Who were they in that company? you may ask. Some of them, however, have a respectable position in the world's history—at least: Benjamin Rush, Nathan Smith, McDowell, and Daniel Drake. Drake is most typical of American conditions in these pioneer days. Benjamin Rush ranks with the systemists of the eighteenth century. He still remains the only product of American medicine in the class of systemists. His actual contributions were not considerable. Nathan Smith is a not less important figure, but much more modern than Benjamin Rush. We can read now Nathan Smith's paper on "typhus" fever, as he called it, and see how far he was in advance of his day. Benjamin Rush made no such contributions as Nathan Smith, but still is a great figure. Daniel Drake is I think and have always thought, the most distinctive product of American medicine, if you emphasize the word American. He is racy and of the soil. He was not trained abroad. As has been set forth, his training was obtained from the medical facilities in this country, the best to be had to be sure, but still relatively meagre. He had, of course, inherent qualities of mind and of character, and when we speak of inadequate education: did not those men, after all, in the frontier settlements have splendid training out in the woods and with nature? Did they not acquire a kind of resource-

[1] **Report of remarks on a paper of Otto Juettner made before The Johns Hopkins Hospital Historical Club, Baltimore, November 9, 1914.**

Johns Hopkins Hosp. Bull., Balt., 1915, XXVI, 34-35.

fulness which was admirable for their future work as physicians? At any rate Drake's work on the "Diseases of the Interior Valley" is one of the great contributions of America to medicine. Read what Hirsch says about it, and the references which he makes to Daniel Drake in his great work on Geographical Medicine, and you will see that Drake has decidedly found his place in the history of medicine. So that looked at from the highest and broadest point of view, Daniel Drake does take a very respectable position in the world's medicine.

Many of these frontier doctors were fully the equals in education of their contemporaries along the Atlantic seaboard; in Boston, New York, Philadelphia and Charleston. Of course in the middle of the eighteenth century, Charleston was perhaps the most cultivated center. There is a wonderful group here that has never been presented to us. I have made many appeals to have this done, by some one from that region if possible. As I said, many of these frontier men were highly trained. McDowell went abroad and studied in Edinburgh, where he was a favorite pupil of John Bell. Bell was an extra-mural teacher, it being impossible to get a university chair of surgery in Edinburgh in the days of the three Monros, and Bell I think was in the time of the second Monro. However, he was a great surgeon in Edinburgh. Benjamin Dudley's name has great renown, particularly to the Kentucky doctors. Ask any one of them and I think you will get the impression that Benjamin Dudley was almost the greatest human being ever created. Drake's is undoubtedly the greater name, but Dudley was a great personal force there. He lived much longer than Drake. I have talked with the McCormacks and other men from Kentucky and I think they put Dudley on a pinnacle by himself. He had four years' study in Paris and in London, where he was a pupil of Astley Cooper and of Abernethy. Consequently, it is not fair to say that those men were not the equals in training of their contemporaries on the Atlantic seaboard. I think it is fair to regard Nathan Smith as a pioneer physician, because New Hampshire and Vermont in those days were just as much pioneer settlements as Kentucky and the Ohio Valley. Altogether it was an interesting group of men who flourished at that time in the pioneer settlements of this country, and I am sure Dr. Juettner's studies of this subject are a valuable contribution to a much neglected topic—the study of the annals of medicine in our own country.

One name incidentally mentioned by Dr. Juettner has interested me. It is that of Charles Caldwell. If you want some of the most spicy and interesting reading of those days, get the autobiography of Charles Caldwell. If you can get a copy of this book, I am sure you will enjoy it.

THE TIMES OF VESALIUS

CONTRIBUTIONS OF VESALIUS OTHER THAN ANATOMICAL[1]

It seemed a pity not to devote one of the meetings of our historical club to the celebration of the four hundredth anniversary of the birth of Vesalius. It was intended to commemorate this on a fitting scale in Belgium during the month of December, 1914, when preparations had been made and interesting exercises had been arranged for in Brussels and at the University of Louvain. It is sad beyond measure to contemplate the situation which rendered it impossible to carry out that intention. However, in this country we have endeavored to do our best in the celebration of this event, exercises having been held in Boston, New York, Washington, and I believe elsewhere.

In these introductory remarks, it seems appropriate to say a few words about the times in which Vesalius lived and did his work, also of his contributions other than those to anatomy.

As you know, Vesalius was born on the last day of December, 1514, and died in 1564. This was an extremely interesting and stirring period. It was the early part of the period of the French Renaissance, the zenith of the Italian period having been reached in the preceding century, or not later than the year 1500. There were a number of events that, taken together, combined to make this one of the most stirring periods of all human history. About the middle of the fifteenth century printing had been invented, and coincident with that was the invention of cheap paper, so that the rapid spread of books, writings and knowledge was made possible. Toward the end of this century—indeed throughout its latter half and the early part of the sixteenth—came the discoveries of the great Spanish and Portuguese explorers, opening up a new world. About the middle of the sixteenth century, 1543, the very year of the publication of Vesalius' great work, the epochal contribution of Copernicus established that theory of the solar system which was eventually to take the place of the Ptolemaic theory. Another great influence to open men's minds to new knowledge was the revival of classical learning—one of the most striking characteristics of the Renaissance. The writings of Hippocrates, of Galen, and of Aristotle were made known as they actually existed and were not deformed by passing through

[1] Report of an address delivered before The Johns Hopkins Hospital Historical Club, Baltimore, February 8, 1915.

Johns Hopkins Hosp. Bull., Balt., 1915, XXVI, 118-120.

many translations. Often these writings were translated from Greek into Syriac, from Syriac into Arabic, thence into Hebrew and finally into Latin before being made known to the mediaeval mind. It is easy to see how distorted the point of view must have been. The revival of classical knowledge brought into prominence one book of great significance for that period which had previously been very little known—the great work of Celsus on medicine.

This was also the period of great painters and sculptors, the age of Raphael, of Titian, of Michael Angelo and of Leonardo da Vinci, indeed one of the greatest periods in the world's history of art. It is very interesting to note that this artistic development had great influence upon anatomy. The artists themselves were often anatomists and loved to make anatomical drawings. Leonardo da Vinci the most varied genius probably who ever lived, a miraculous combination of art and science, apparently manifesting every capacity of the human mind, ranks as a great anatomist. The importance of his work in anatomy was hardly appreciated until his plates were studied by William Hunter in the eighteenth century. The development of art undoubtedly had a most stimulating effect on anatomical drawings and illustrations and in that way on the development of anatomy. It was surmised at one time that some of the plates in Vesalius' "Fabrica" had been made by Titian, but I believe this has been disproved.

This was also a marvelous period in literature, both in poetry and in prose. It is interesting to recall that one of the great names of French literature, Rabelais, was a medical man and a contemporary of Vesalius. Rabelais partly edited an edition of Hippocrates and himself dissected. He was a teacher in Montpellier, where he had also studied, and was actively identified with the profession of medicine.

As regards science, this was not the great period for natural and physical science, but rather a period of reawakening—a transitional period. The roots of the great developments in experimental science of the following century are to be sought for in the sixteenth century, but the sciences of observation and the descriptive sciences like anatomy, botany, zoology, and to some extent geology and mineralogy, all had notable development at this time. Leonardo da Vinci was one of the greatest figures in the development of geology.

In botany it was the fascinating time known as the age of the herbalists, a collection of whose works forms a most interesting task for the book lover. The herbalists had much influence on medicine. Indeed most of them were physicians.

Modern zoology dates from Gesner and Aldrovandi. Gesner was a contemporary of Vesalius and was a botanist as well as a great zoologist. His botanical works were not published until much later, but his zoological works appeared during the sixteenth century.

This was also an interesting age with regard to medicine. We think of the humanists in medical history as a particularly characteristic and charming type. They were good physicians and among them there is no better example than our English medical hero, Thomas Linacre, who founded the Royal College of Physicians in the reign of Henry VIII. The medical humanists were characterized by love of classical learning, and often believed that the salvation of medicine rested on going back to the original writings of Hippocrates, of Galen, of Dioscorides and of Celsus.

This was a time also when certain diseases either became known or else were accurately studied for the first time, and we find something approaching a good portrayal of disease based on accurate observation. That, of course, was not the dominant note, but this characteristic may be picked out in the writings of certain physicians. A good example is the monograph on the sweating sickness by John Caius, the founder of Caius College. About the end of the fifteenth century syphilis began to spread with appalling severity, and the study of this disease was taken up by a number of physicians. It was found to be quite irreconcilable in its interpretation and especially in treatment, with the prevailing Galenic doctrines of pathology. The study of these epidemics, then, marked a certain attack upon the authority of Galen.

The three great names of the sixteenth century in medicine are those of Vesalius, Paracelsus and Ambroise Paré, all others being more or less overshadowed by them. There are other interesting names, also, as we pathological anatomists like to recall. That of Fracastorius, for instance, who is one of the most fascinating of figures. I do not believe justice has been done to him yet. He lived in the humanist circle in Florence and also in Padua. He was a poet and wrote on a subject that would hardly be conceived as admitting of real poetic treatment—syphilis—but the work is conceded to have actual poetical merit, besides being historically important from the fact that we date the name syphilis from this poem.

Paracelsus was one of the greatest figures of this period—that iconoclastic genius, typical perhaps of the German Reformation, who is sometimes spoken of as the Luther of medicine, and who was the enemy of Galen, Aristotle, in fact of all authority. The Germans give him, I think, a degree of influence which others are not inclined to allow, but he was indeed a remarkable character.

Ambroise Paré is another of the great figures. He is identified with the history of surgery. The life of Paré is a fascinating study in many ways. It is interesting to recall that his is one of the well known names in French literature. Paré figures as one of the writers of terse, vigorous prose at a time when French prose was being established as an adequate medium expression.

However, our main interest lies with Vesalius. He was born in the city of Brussels, and was of German ancestry. His father was Court Apothecary to Charles V, and it was evident that the family had some influence. Vesalius received his education in classical studies at the University of Louvain. This was the usual education of the day—Latin, Greek and mathematics. That which has come to be known as our modern system of liberal studies was practically worked out at this period of the Renaissance. Louvain was not noted as a university for humanistic studies. Indeed Erasmus, who was there at this time, felt much more at home in Holland, or in Basel.

In about his eighteenth year, Vesalius went to Paris for his medical education. Here he was the pupil of Jacobus Sylvius. Other teachers at that time were Jean Guinter Andernach and Fernel. At Paris, Vesalius was a fellow pupil of Servetus, the discoverer of the lesser circulation from the right to left heart. Vesalius pictures this period of his studies at Paris as lamentably deficient. He described his teacher, Jacobus Sylvius, in a most unattractive light and says that his opportunities for study were poor indeed. The picture that Vesalius gave of Sylvius is the traditional one, although I believe there is some reason to think that it may have been overdrawn. When Vesalius had been in Paris for about three years, the war between Francis I and Charles V broke out, in consequence of which Vesalius returned to Louvain, where he remained for about a year. He also served for a few months in the army of Charles V.

About 1537 Vesalius reached Venice and the next six years form the most productive period of his life. The university belonging to the Republic of Venice was at Padua, where the spirit was probably freer than in any other part of Italy. After having been appointed to make public dissections at the University of Padua, Vesalius was made professor of surgery, including anatomy. John Caius was a pupil of Vesalius at this time. Another interesting contemporary, although a little later, was Montanus, who taught medicine by bedside instruction. The history of clinical teaching dates from this period at Padua. It was during these years that Vesalius prepared his great work, the "Fabrica," which was published in 1543. Before this he had published another work, the "Paraphrases of the Ninth Book of Rhazes," which was practically an inaugural dissertation. Vesalius received the degree of M. D. in Padua, although he had previously received it in Basel. This first publication of Vesalius was a type of work very common in those days, being partly a translation and partly a commentary. For this work he selected the most interesting book of Rhazes, that relating to the treatment of disease. This appeared in 1537. It was in 1539, I think, that Vesalius published a little work entitled "An Epistle on the Selection of the Vein to

be Bled." It is interesting from the fact that he took part in a discussion of that century between the Arabists and the Galenists, or the anti-Arabists. The doctrine of the Arabists was that known as revulsion, which claimed that in bleeding, especially in pleurisy (probably what we would now call pneumonia) the patient should not be bled on the side where the pain was felt, whereas Hippocrates had taught that one should bleed on the side of the disease, or on the side of the pain. This may seem but a trifling matter, but it shook the entire continent. Popes were appealed to, Charles V was asked to give his judgment—indeed it is one of the most interesting examples of the state of mind of medical men of the period in their attitude toward the writings of the Arabist physicians and in their return to Hippocrates. Vesalius was against revulsion.

The dedication of the "Fabrica" to Charles V was written in 1542 and Vesalius went to Basel to superintend the publication by the firm of J. Herpst, one of the publishers of the day. The printers in those days were often wonderful men and scholars of the highest rank. Among them were the Aldines in Venice, one of them a great anatomist also. It is known that Erasmus went to live in Basel on account of the publishing firms there. Vesalius' "Epitome," nowadays an extremely rare volume, appeared in 1543.

From the time that Vesalius secured his leave of absence to go to Basel, a most extraordinary change took place in his life. He was at that time in his twenty-ninth or thirtieth year, which marked the end of his career as a productive worker. When he went back to Padua his work had been published. It produced a great sensation, because the essential characteristic of his attitude is his correction of the errors of Galen on the basis of actual observation of human dissections. Vesalius really made modern anatomy. It has gone on developing continuously from that period. Indeed he gave it a prominence in the medical curriculum which it is only just beginning to lose. For years it was the only subject the students came into contact with directly by observation and so it had an educational value that no other subject could have.

The publication of the "Fabrica," as I said, raised a storm. Vesalius' own teacher, Jacobus Sylvius, published a scandalous attack upon him. That is where Sylvius did himself great harm. One of Vesalius' pupils, Colombo, was a great antagonist and apparently an intriguer. When Vesalius returned to Padua, he found the situation exceedingly unpleasant and became greatly discouraged; it is not apparent why he could not have gone on lecturing, but he was greatly disheartened and burned his manuscripts. His scientific career practically ended here, although he lived until 1564. He afterwards became Court Physician to Charles V and had a lucrative and probably fashionable practice, but his life as a man of science was over, all

of his work having been done before he was thirty years of age. A most excellent description of Vesalius is to be found in a volume by Sir Michael Foster "Lectures on the History of Physiology." It is supposed that a very attractive offer from the emperor may have had something to do with Vesalius' withdrawal from his chair at Padua. After this, his most interesting publication was the one on the China root, with which he treated the emperor. The book contains a great deal of personal matter for the biographer of Vesalius and makes interesting reading of the times.

In 1563 Vesalius started on a pilgrimage to Jerusalem, no one knows exactly why. The most common theory is that in making a post mortem examination and opening the chest, the heart was found beating. In other words he was doing a vivisection, supposing he was making a post mortem. It is said he was brought before the inquisition and that, the emperor having used his influence, he was told if he would go on a pilgrimage the proceedings would be stopped. Another explanation is that his domestic life was exceedingly unhappy and he seized an opportunity to escape. Still another version has it that his court life had become wearisome to him. At any rate he started out on this so-called expiatory pilgrimage. He went to Venice first and there received an offer to come back to his old chair at Padua, which he agreed to do on the completion of his voyage. On his way to Jerusalem he was shipwrecked, however, and died on the Island of Zante.

Sir Michael Foster in the first chapter of his "Lectures on the History of Physiology" during the sixteenth, seventeenth and eighteenth centuries, speaks of Vesalius more than once as the founder of physiology, by which he means the founder in the sense that a knowledge of structure is essential for the development of physiology. It is not meant in the sense that he made important contributions to our knowledge of the activities and functions of organs. Of course with that conception, Vesalius' work was epoch-making for physiology, just as it was for medicine in general. Vesalius was essentially Galenic in his physiology. This is what he says of the central point in the Galenic doctrine of the physiology of the circulation. In that doctrine the blood is made to pass from the right ventricle to the left ventricle through invisible pores in the septum between the ventricles. Vesalius says:

"The septum of the ventricles, composed as I have said of the thickest substance of the heart, abounds on both sides with little pits impressed in it. Of these pits, none, so far at least as can be perceived by the senses, penetrate through from the right into the left ventricle, so that we are driven to wonder at the handiwork of the Almighty, by means of which the blood sweats from the right into the left ventricle through passages which escape human vision."

This was interpreted usually as unintentional sarcasm, but Vesalius has nothing to substitute for the view of Galen. However, he tells us in a later writing that "he accommodated his statements to the dogmas of Galen," not because he thought that "these were in all cases consonant with truth but because in such a great work he hesitated to lay down his opinions and did not dare to swerve a nail's breadth from the doctrines of the Prince of Medicine."

We owe to Foster the credit for calling attention to certain contributions of Vesalius to physiology. He writes as follows:

"That physiological problems were before his mind, that he had thought over, and indeed had tried to solve them by experimental methods is shewn in the brief chapter 'Some Remarks on the Vivisection of Animals," which is the last chapter in his great work. In this he relates his experiments on muscle and nerve showing that that which passes along a nerve in order to bring about movement passes by the substance and not by the sheath of the nerves. He tells us that it is through the spinal cord that the brain acts on the trunk and limbs, that an animal can live after its spleen has been removed, that the lungs shrink when the chest is punctured, that the voice is lost when the recurrent laryngeal nerve is cut, that by artificial respiration an animal can be kept alive though its chest is laid wholly bare, and that under these circumstances a heart which has almost stopped beating may be revived by the timely use of the bellows.

"Obviously his vigorous and active young mind was starting many inquiries of a purely physiological kind, and he was aware that much of the physiology which he had put into his book would not stand the test of future research. He knew more particularly that the chapter in that book in which he treated of the use of the heart and its parts was as he says 'full of paradoxes.' But he was no less aware that his bold attempt to expound the plain visible facts of anatomy was itself enough to raise a storm of opposition; he feared to jeopardize his success in that great effort by taking upon himself further burdens."

You will observe that Sir Michael Foster attributes Vesalius' Galenic explanations in describing the structures to the fact that he did not wish to jeopardize the success of his great work by any deviation from more or less canonical authority. Foster also comments on the fact that Vesalius anticipated Descartes in the idea that mental activities were a product of the brain.

Another very interesting side of Vesalius is that he was an anthropologist. He was much interested in the shape and character of the skull and noted in his examinations the flattening of the occiput which he regarded as characteristic of the German race. The Germans he examined, however, probably belonged to the brachycephalic Alpine race, not the long-headed Nordic type.

TWO PHYSICIAN-ECONOMISTS

SIR WILLIAM PETTY, 1623-1687; FRANCOIS QUESNAY, 1694-1774[1]

It is very interesting to consider physicians who became distinguished in other branches of knowledge. I have myself been more or less interested in this subject, considering for instance, physicians who have been classical scholars, physicians who have been astronomers, physicists, etc. There have been many physicians eminent in the natural sciences. Dr. Kelly, for instance, has brought together the physicians who have been botanists. There have also been zoologists. This is all more or less familiar ground. It is much less common to find those eminent in physical sciences, but still the list is interesting and considerable. Those who have become eminent in the social sciences are relatively few. I rather think this is due to the fact that medicine had become rather highly specialized by the time the social sciences were developed. The points Dr. Hollander brought out as to the relationship between medicine and the social sciences were extremely interesting. So also is his list of physicians. I think there is perhaps one name that might be added—that of Copernicus, with his essay on money. He was educated in medicine and actually practised it.

The two names selected for special consideration—Petty and Quesnay—are men very different in their lives and work. Each was the child of his time. Petty belongs to the group of men first at Oxford and later at London who developed the so-called new philosophy, himself the very center of that group and one of the founders of the Royal Society. But similarly Quesnay was the child of the so-called philosophical century, and the chief medical representative in medicine among the encyclopaedists, as they were named.

The relation of Petty to Graunt is very interesting. Graunt is doubtless the founder of the science of vital statistics. His materials were the bills of mortality collected by the parish clerks, unfortunately ages not being included. This was an ecclesiastical function and it remained in the hands of the parish clerks until 1836, when the *Birth and Death Registration Act* was passed. Capt. Graunt was a London shopkeeper, who first saw the various uses to which the study of vital statistics could be applied. Petty was an important figure not only in medicine and science but also in

[1] Report of remarks on a paper of Jacob H. Hollander, Ph. D., made before The Johns Hopkins Hospital Historical Club, Baltimore, March 8, 1915.

Johns Hopkins Hosp. Bull., Balt., 1915, XXVI, 256-257.

political life. He brought out the later editions of Graunt's work and introduced the name political arithmetic for what is now called vital statistics. It is very interesting to consider the influence which the analysis of the bills of mortality—that is, the returns and registration of births, marriages, and deaths—has had upon the development of preventive medicine. Petty and Graunt were most interested in its practical bearings. The astronomer, Edmund Halley, a contemporary of Sir Isaac Newton, found that for several years the city of Breslau had added the ages to the list of births, deaths and marriages and thus formed the first life table on principles essentially like those used today. Süssmilch in the eighteenth century is regarded as one of the modern founders of statistics but his bias was theological. The practical application of the knowledge thus derived was really made in England partly in the eighteenth but mainly in the third and fourth decades of the nineteenth century.

The English physicians, Percival in Manchester and Haygarth in Chester, were pioneers in applying information derived from statistical studies of the incidence and extent of communicable disease, to the control of these diseases. Had it not been for the interruption of the Napoleonic Wars it is probable that the movement thus initiated would have been developed much more rapidly. Haygarth took a census, based on a questionnaire relating to the fevers prevalent in the city of Chester in the latter part of the 18th century. He advocated the isolation of patients affected with communicable diseases and the establishment of special hospitals and wards for their diseases. It was in 1836 that the famous *Birth and Death Registration Act* was passed and the Registrar General's Office established, twelve years before the *Public Health Act of* 1848. It was from the data collected by the Registrar General during these earlier years that affective practical measures in hygiene and preventive medicine were introduced in England. In this connection one name should never be forgotten, that of Dr. William Farr, who was connected for over forty years with the work of the Registrar's office, and who is in many ways the most important and interesting figure in the whole domain of vital statistics. His letters published in the reports of the Registrar General are classical.

Quesnay is really an interesting character in medicine as well as in economics. He was a much more highly educated surgeon than most of those of his day and was really the spokesman of the surgeons after the establishment of the Academy of Surgery. One of the most acrimonious controversies in the whole history of medicine and the most discreditable in many ways, took place in regard to the establishment of the Academy of Surgery. The Academy of Medicine desired to keep the surgeons under their control

in every way. Finally royal assent to the establishment of the Academy of Surgery was secured. Quesnay was the second secretary of this academy. He it was who edited its Memoirs. His preface to the first volume is still well worth reading. It is rather interesting to consider the champion on the other side. His is a name that started a new line of thought and investigation and is as famous as Quesnay's. Astruc was a Professor of Medicine in the Paris Faculty of Medicine when Quesnay was the secretary of the Academy of Surgery. Astruc is best known in medicine by his two great volumes on the venereal diseases, which still have much historical interest. But Astruc is an important name in the historical development of the higher criticism of the Bible, for it was he who first noted the two documentary sources of the Pentateuch known as the Elohistic and Jahvist, which forms the starting points of this criticism. It is interesting that on the one hand we have Quesnay, the surgeon, as a contributor to economics, and on the other his great opponent, Astruc, identified with the first important work in the so-called higher criticism of the Bible.

I have brought here the familiar translation by Ottley of some of Quesnay's writings. His remarks on wounds of the brain are most interesting, with his plea for careful surgical intervention in diseases of the brain, based upon an analysis of cases that came to post mortem examination.

THE DEVELOPMENT OF ENGLISH MEDICINE AS REPRESENTED IN A COLLECTION OF MEDICAL PORTRAITS[1]

We are all deeply indebted to Mr. Randall for this delightful gift to supplement the Fisher collection, which we owe to the generosity of Dr. Kelly. It is good to be surrounded by portraits of medical men and to cultivate an interest in the iconography of medicine. We have endeavored here to create that sort of an atmosphere. It is not always perhaps best secured by efforts which seem to be most direct for the purpose, but sometimes by indirect methods of attack you may inspire in the student an interest which adds much to the life and enjoyment of the physician in his profession, and which makes all the difference between the practice of medicine as a profession and as a money making trade.

Medical portraiture is a specialized subject and I cannot claim any expert knowledge of it. One of the most famous medical paintings in the world is Rembrandt's "School of Anatomy." Dr. Garrison has selected another "School of Anatomy" to illustrate his excellent book on the history of medicine, and there are several others. The Guild pictures of the seventeenth century are also extremely interesting. The greatest of those are the Franz Hals pictures in Holland. I recall visiting a hospital in Delft where there was a magnificent picture of medical men.

Mr. Broedel has presented very delightfully the artistic side of portraiture. Those interested in history and biography find an interest in portraits in general quite apart from the artistic merits of the picture: I know of no one who has expressed that quite so well as Carlyle in one of his letters written in 1854. I do not know that I have ever seen a better expression of the kind of interest attached to a portrait.

I am somewhat at a loss as to what to say on this occasion. A number of thoughts have occurred to me, and one is: Whose likeness is apt to be perpetuated by a painter and especially by one of the great masters of painting? What doctors are likely to be painted by Holbein, or Van Dyke, or Sir Peter Lely, Sir Joshua Reynolds or Gainsborough? What sort of a record would we find if the names were selected on the basis of the preservation of the likeness of such great physicians? One can determine that by looking over

[1] Report of remarks at an exhibition of medical portraits, made before The Johns Hopkins Hospital Historical Club, Baltimore, May 15, 1916.

Johns Hopkins Hosp. Bull., Balt., 1916, XXVI, 276-279.

the names of the great surgeons and physicians to see if they were ever painted and, if painted, whether by first class or cheaper artists. Certain ideas occur to me. Many probably took no interest in being painted. Others may have been connected with a hospital or an institution, or perhaps made some benefaction, and may have been painted at the solicitation of the authorities of that institution. We find here, for instance, a wonderful portrait of John Ash painted by Sir Joshua Reynolds. John Ash was very active in founding a hospital, which is seen in the background of the picture. He afterwards went to London to live, and the trustees of the hospital thought it would be wise to perpetuate the portrait of John Ash, who was not a figure of any importance in the history of medicine, but who founded a hospital and so got his portrait painted. There is another excellent portrait here of a man I never heard of before—Remmett, a Plymouth physician. He was very active in founding a medical society in Plymouth and so he lives for all time in this fine picture. Then again, a man may have done some great service, like Woodville who went to France with the first vaccination treatment. The people in France subscribed for this interesting portrait of Woodville, and he deserved it.

Again, I think you will suspect that the great, wealthy and fashionable practitioners are pretty sure to have been painted, and that indeed is the case. There is no portrait of William Heberden that compares with the portrait of Richard Warren his contemporary, who was a fashionable physician in London, but who contributed nothing to medicine; whereas Heberden's is one of the great names in medicine. Warren had a large practice and was a good doctor in that day. He made more money than any one else prior to his time, and he was painted by Gainsborough and also by others.

The great surgeons of the early part of the nineteenth century were deserving of being painted. Sir Astley Cooper and Abernethy were sure to have been painted by the leading men of their time.

From that point of view, it is somewhat interesting just to run over the list. I have made a memorandum, not very accurate, of English physicians, beginning with the early part of the sixteenth century, Linacre, Kaye or Caius and Sir Theodore Mayerne. Then in the early part of the seventeenth century there were Harvey, Burton, Glisson and Mayo, who typified the spirit of their day. In the eighteenth century, the days of Steele, Addison, Pope, Pryor and Gay, the doctors who belonged to the same circle, and who held their own there, were Garth, Arbuthnot, Meade and of course John Radcliffe. This takes us up to the days of Matthew Baillie and Sir Henry Halford. Matthew Baillie was painted beautifully, but Halford was the figure of the day in medicine.

It is interesting to think of who were the great painters at the same period. What a glory to have been painted by Holbein, or later by Van Dyke, or Sir

Peter Lely or Sir Godfrey Kneller. Then comes the English school of the eighteenth century with such great names as Sir Joshua Reynolds, Gainsborough and Romney, with Raeburn in Scotland. Remembering these names, it is worth considering how the great doctors fared. Who was painted by Holbein? Sir William Butts! It is a wonderful picture, indeed one of the greatest in the world. He was painted twice by Holbein, and his wife was also painted. Butts was the court physician to Henry VIII and had great influence with him, but he contributed nothing to the advancement of medicine. However, he is in one of the most famous pictures in the world, that of Henry VIII giving the charter and seal to the Barber-Surgeons' Corporation. This was founded in 1540 and the picture represents John Chambre, with Butts on his right hand. The King is handing the charter to Thomas Vicary. Dr. John Chambre is perhaps the only one you have heard a little about. Butts was not the founder of the corporation, but Chambre was, and Linacre was one of its great names. There is a separate picture of Chambre by Holbein, which hangs in the galleries in Vienna. Linacre was also painted and the portrait is attributed to Quentin Matsys, but this is not probable. There are several portraits of Caius, or Kaye, but none by artists who were very well known.

Sir Theodore Mayerne was undoubtedly the leading practitioner of his day and a most interesting man. He comes off pretty well. There is a beautiful drawing in color of him by Rubens in the British Museum. Harvey was painted by Cornelius Johanssen, and there is an oil painting of Harvey, which is probably contemporary, in the Hunterian Museum in Glasgow.

There is a very interesting painting of Sir Charles Scarborough, the physician of Charles II, painted for the Barber-Surgeons' Company, by Robert Greene. Then comes Sir Francis Prujean, who lived in the middle of that century, who was president of the Royal College of Physicians, and who was painted by a quite insignificant painter named Robert Streeter. Pepys says of Streeter: "A very civil little man and lame, but he lives very handsomely." Streeter was eulogized in a poem, from which I have taken two lines:

> "That future ages must confess they owe
> To Streeter more than Michael Angelo."

There is a portrait of Glisson, but the painter is not known. Boyle was a very busy man, who did not care very much about being painted, although there is a portrait of him by Frederick Kerseboom.

Who was painted by Van Dyke? Sir Kenelm Digby, who figures in the practice of medicine by his quackery. Valentine Greatrakes was another great quack of that period. There is a very interesting portrait of him by William Faithorne. The seventeenth century was, if anything, characterized

by more quackery than the period in which we live. I think you can establish the thesis that charlatanry flourishes rather in a ratio to the development of science. All periods of great scientific enlightenment are always characterized by great charlatanry and quackery. This was true of the eighteenth century and it is true today. Greatrakes was a wonderful quack.

The best of the Scottish group were of course painted by Raeburn. Sir Hans Sloane was repeatedly painted by Kneller. Radcliffe was also painted by Kneller, as was also Sir Samuel Garth, a member of the Kit-Kat Club, whom you will remember from the interesting paper presented here by Dr. Harvey Cushing some years ago. There is also a drawing of Garth by Hogarth, which is of course very interesting.

Richard Wiseman was the first really great English surgeon. He was very much admired by Dr. Johnson. There is a very fine miniature of him by Samuel Cooper. Cheselden was painted by Richardson. William Hunter was admirably painted by Sir Joshua Reynolds. Percival Pott was also painted by Reynolds, and there is an excellent portrait of him by Romney. Sir Caesar Hawkins, who was not a great man, was painted by William Hogarth.

The man who took the place of Kneller during the same period in Scotland was Medina, a Spaniard, who painted Archibald Pitcairn. Alexander Monro *Secundus* was painted by Raeburn, who is sometimes called the Scottish Reynolds. He was a most interesting painter and a man whose fame has steadily increased.

Among the portraits exhibited tonight, one of the earliest is that of de La Mettrie, a physician celebrated in the history of philosophy. He advanced the most extreme mechanistic view of man that I suppose has ever been taken. His great work is called "La bonne machine," and he looked upon man as being nothing more than a piece of machinery. He could not live comfortably in France, so he went to Holland, which was quite a refuge at that time; but he did not remain there very long and traveled still farther to find a congenial resting place.

Claude Perrault is a very interesting figure in the seventeenth century. He was a physician who practised and wrote, and he was also a great architect. It is very interesting to collect the performances of physicians outside of their profession. In that respect we can almost claim Sir Christopher Wren, who belonged to the group of doctors at Oxford in 1650, the group which led to the formation of the Royal Society. It was a most fascinating period, and Sir Christopher Wren, whose name simply occurs to me, was one of the greatest architects. So also with Claude Perrault. He was a brother of that Charles Perrault, whose fairy stories are models of their kind.

Here is a portrait of Huyghens, who was a great mathematician, anatomist and physicist. He made wonderful studies in physical optics and prepared the way for Newton's corpuscular theory and for Sir Thomas Young, the great physician who brought forward the wave theory of light.

Philippe Collot was one of the great lithotomists of that period. Those were the days when cutting for stone was a separate specialty. There were many traveling quacks, and some very interesting characters among them.

Albinus was one of the greatest anatomists, teachers and illustrators who ever lived. He was a professor in Leyden, a younger contemporary of Boerhaave. It was to Leyden in this period that the Scotch and English students went.

Sir Thomas Millington was a professor at Oxford and president of the Royal College of Physicians. He belonged to that group I have spoken of, "the invisible college," and was one of its most distinguished members. Indeed, I think anyone Sydenham thought was a good doctor must have been, as he did not care much for most of his colleagues.

Here we see Thomas Pellett, a physician in the first half of the eighteenth century. He was the friend of Radcliffe, Arbuthnot, Freind and Sir Hans Sloane. Arbuthnot is perhaps the best known of the group on account of his intimacy with Pope.

Alexander Monro the Second was the great Monro. From 1725 until we approach 1840, the three Monros were professors of anatomy at the University of Edinburgh. The first one was a very eccentric man. The second was very distinguished: he was trained in Germany and was a most admirable character. The third was not to be classed with either of them. They resisted efforts at reform in medical education in Scotland, and especially resisted the establishment of a chair of surgery, which did not exist until well on in the nineteenth century.

Here, by Sir William Beechey, a contemporary of Sir Thomas Lawrence, is a portrait of Sir Everard Home. The indelible stain rests upon Home's name of having destroyed the valuable manuscripts of John Hunter.

And here is a most interesting portrait of William Woodville, of whom I have already spoken. He plays a great part in the introduction of vaccination. Indeed, the anti-vaccinationists contend that, if it had not been for Woodville, vaccination would never have succeeded. He was an eminent medical botanist and wrote a botany in four volumes. He was physician in the inoculation hospital in London. At first he was opposed to Jenner, but afterwards became one of the leading vaccinationists. He obtained cowpox lymph and at this hospital practised vaccination.

Henry Harrington's portrait is very interesting. It was painted by Thomas Beach, who was a very actively employed painter of his day. Har-

rington was a physician in Bath and is best known for his history of music. He comes straight down from Sir John Harrington, of whom I am sure some of you know.

Joseph Black's is perhaps the greatest name on the list. He was both a chemist and a physicist. Never did a medical student publish a graduating thesis comparable to his. He was a medical man and a pupil of Cullen. He was a professor of chemistry first in Glasgow and later succeeded Cullen in Edinburgh. He was the discoverer of what was, perhaps unfortunately, called latent heat. He was an excellent teacher and an active man in the wonderful circle in Edinburgh.

I shall pass over Vogel, who was a professor of anatomy and medicine, and John Heaviside, who was surgeon extraordinary to the king and who collected a museum. This was in the period after John and William Hunter, when all were collecting anatomical specimens.

Here is a lovely picture of Matthew Baillie, the nephew of John and William Hunter and a brother of Joanna Baillie. He was taught by William Hunter and succeeded him in the Great Windmill Street School. From teaching and investigating work, he became the leading physician of London. His "Morbid Anatomy" published in 1795, while it has not the significance of Morgagni's, is the first work devoted exclusively to that subject and presented it just as we do today.

We next come to Lucas, who gets several pages in the Dictionary of National Biography. He was a painter as well as a doctor.

Berthollet was a great chemist, indeed he was one of the founders of physiological chemistry. He was painted by Rembrandt Peale, a son of Charles Wilson Peale. There were about eight of the Peales who were painters. Charles Wilson called his sons by such names as Rembrandt, Raphael and Titian, and they all painted. Rembrandt studied with Benjamin West and afterwards worked in Paris. He was an extraordinarily versatile man.

A most fascinating doctor was John Mudge. He was a Plymouth man and one of the famous provincial physicians of England. Mudge well deserves to be perpetuated. He was quite interesting, as was his father before him, Zacharias Mudge, the subject of that wonderful Johnsonian epitaph. The son was the friend of Joshua Reynolds and Samuel Johnson, who visited Plymouth and were entertained by Mudge. Johnson used to consult Mudge about his ailments. At one time an operation was proposed and he wrote to Mudge something in this line: "It probably is painful, but is it dangerous? I hope to bear the pain with decency, but I am loath to subject myself to much danger." Mudge was a charming man, and the London physicians used to send their patients to him on account of the life-giving qualities of his talk and personality. He was painted by Sir Joshua Reynolds.

Joshua Brookes was head of one of the private schools. This movement began in the eighteenth century and led to the Great Windmill Street School. There were many other schools and one of the most celebrated was Joshua Brookes'. Most of the Americans studied in these schools, and when the time came to do away with them and have hospital schools, there were all sorts of complications.

Larrey is celebrated as an oculist. Jenner, Dalton, Remmett, Cuvier and Cooper are also interesting. Cooper was a professor of surgery at the University College and wrote a surgical dictionary. Owen was a prosector for Abernethy.

Here is a beautiful portrait of Abernethy, who was one of the greatest teachers who ever lived. It is interesting to contrast Abernethy with his contemporary Sir Astley Cooper. They are very different men. Abernethy is to be regarded as the custodian of John Hunter's ideas and thoughts. He expounded Hunter's doctrines and especially that doctrine of the constitutional origin of local diseases, the treatment for which was characteristic of English medicine for a long time—dieting the patients and giving mercury, calomel and purges. All that comes from Abernethy, who was one of the great characters of medicine and who made a tremendous impression on his pupils.

Sir George Johnson's is another example of a painting having been done at the instance of the hospital and the pupils. His beautiful picture was painted for King's Hospital, which he served for many years. Johnson's name is identified with Bright's disease which he studied for a long time.

I have not begun to express really the interest there is in tracing the history of medicine as one can from these portraits here. I hope I have indicated to you how fascinating it is to take any one of these men and fit him into his environment, and how much it adds to that kind of study to have these charming portraits with us.

INFLUENCE OF ENGLISH MEDICINE UPON AMERICAN MEDICINE IN ITS FORMATIVE PERIOD[1]

Important as has been the impulses derived from other sources, kinship, community of language, and intercourse have combined to render the influences coming from England and Scotland the dominant ones in the development of American medicine. This statement is particularly applicable to the colonial period and the first half century of the independence of the United States.

After this formative period medicine in America assumed a more independent character. In the thirties and forties of the last century it received a great and beneficial impulse from France, as has been set forth so admirably by Osler in his charming paper on the American pupils of Louis. Still later from the seventies onward the greatest stimulus came from Germany, whither flocked a multitude of aspiring American students. This influence was marked especially by the development of pathology, bacteriology, and chemistry and by the establishment of laboratories. These later foreign influences, important as they were, were exerted upon a profession and a medical art already established which was predominantly English and Scottish in origin and character.

The meager body of medical knowledge brought from England and Scotland by Thomas Wotton and Samuel Fuller and the little band of their successors in the seventeenth century was considerably increased by immigrant physicians and returning students, by importation of books, and by correspondence in the following century. It was transmitted mainly by the apprenticeship system. That the spirit of inquiry was not absent is shown by the additions to the indigenous materia medica, some of which have retained a permanent place, and by the introduction by Cotton Mather and Zabdiel Boylston in Boston of the practice of inoculation against smallpox almost simultaneously with its introduction in England, but quite independently, and with a skill and success equal to that attained elsewhere. The eighteenth-century story of inoculation has much the same interest and runs much the same course in America as in England.

Before the end of the eighteenth century substantial contributions had been made to the knowledge, prevention, or treatment of the three great

[1] As this paper has been written upon a steamship, crossing to France, without access to books or notes, it has not been possible to insert references.

Contrib. Med. & Biol. Research, dedicated to Sir Wm. Osler . . . . by his pupils and co-workers, N. Y., 1919, 811-817.

epidemic diseases which in succession sorely afflicted the colonies, namely smallpox by Zabdiel Boylston, diphtheria by Samuel Bard, and yellow fever by Matthew Carey, William Currie, and Benjamin Rush. Samuel Bard's "Enquiry into the Nature, Cause and Cure of the Angina Suffocativa or Sore Throat Distemper," William Currie's "Historical Account of the Climates and Diseases of the United States," and Noah Webster's "Brief History of Epidemic and Pestilential Diseases," are the works of greatest permanent value to medicine published in this country before the close of the eighteenth century, although we cherish John Morgan's "Discourse upon the Institution of Medical Schools in America" as a precious document of our medical literature.

While Philadelphia was the medical center of America in the eighteenth century and later, and the names of its medical leaders—Colden, Cadwalader, Bond, Morgan, Shippen, Jones, Redman, Rush, Wistar, Kuhn—sufficiently indicate their origin, there was no more cultivated and attractive group of medical men in the third quarter of the eighteenth century in America than that in Charleston, S. C., which has been so well pictured by Mumford. Of these Bull was a pupil of Boerhaave, and Chalmers, Moultrie, Lining, and Garden were trained in Edinburgh. These men were abreast of the knowledge of the day; some were naturalists as well as physicians, their names being perpetuated in those of plants, fellows of the Royal Society, and correspondents of Linneaus, Fothergill, and other European savants.

After the Revolution American medicine assumed a character of greater independence and reliance. Elihu Hubbard Smith, the father of American medical journalism, established in 1797 "The Medical Repository," which survived until four years after the foundation in 1820 of the journal now known as the "American Journal of the Medical Sciences."

The most important channel of foreign influence is that of education, and it is fortunate that so vigorous and healthy an influence as that of the University of Edinburgh inspired the ideas of Morgan, Shippen, Bard, Hosack, and other founders of medical education in this country, who had been taught by Cullen, the Monros, Black, the Hamiltons, Gregory, the Bells, and other leaders of the Edinburgh School. These were the influences which presided over the foundation of the Medical School of the College of Philadelphia—later the University of Pennsylvania—in 1765, and that of Kings College—later Columbia University—in 1768. We should always recall with gratitude the deep interest and support and advice of Cullen and of John Fothergill and later Lettsom, the delightful Quaker physicians in London, who were friends, counselors, and correspondents of so many American medical students and physicians in the latter part of the eighteenth century.

The rise in the nineteenth century of the many detached proprietary medical schools scattered over the land, sometimes in small country towns, is a phase of our medical history, peculiar to the United States, which we cannot contemplate with satisfaction. Acquaintance with the separate medical schools in London in the later eighteenth and early nineteenth centuries, such as the famous Great Windmill Street School, founded by William Hunter, Sheldon's Great Queen Street School, Marshal's School at Thavie's Inn, Brooke's School, the Webb Street School, the Little Dean Street School, and others frequented by American students, may have had some influence, but neither these nor the hospital schools in London were empowered to grant the doctor's degree nor the license to practise, we must recognize the movement for separate schools as in the beginning a response to the urgent needs of the country for a rapid supply of physicians.

Objectionable as the system was in many respects, and inexcusably long as it lasted, the results were better than might have been anticipated, as defects were in a measure counterbalanced by the devotion of excellent teachers and by the native intelligence and industry of the pupils. A unique product of these local conditions was the peripatetic professor, strikingly exemplified in the person of John Delamater.

The influence of English as distinguished from Scottish Medicine upon America was most marked in the latter part of the eighteenth and the first three decades of the nineteenth centuries. This came largely from the great London surgeons, Percival Pott and John Hunter and their successors, especially Abernethy and Sir Astley Cooper.

John Jones, who begins the line of American surgeons with his book for army surgeons entitled "Plain Remarks Upon Wounds and Fractures," published just before the Revolutionary War, had been a pupil of Percival Pott, John Morgan, Richard Bayley, and William Shippen, Jr., studied under William or John Hunter. The list of American pupils of Sir Astley Cooper is a long one, and includes the names of John Collins Warren, James Jackson, Valentine Seaman, Valentine Mott, Dorsey, William Gibson, Alexander H. Stevens, John Kearny Rodgers, Edward Delafield, B. W. Dudley (also a pupil of Larrey), John Wagner, and others. Physick was almost as much a mouthpiece of the doctrines of John Hunter in America as Abernethy was in London.

As the Monros prevented the establishment of a chair of surgery in the University of Edinburgh until well into the nineteenth century, although John Bell was an excellent extramural teacher, early American surgery was derived mainly from the London group, and to this we may attribute the interest in anatomy, normal and pathological, which has characterized American surgery. We owe to a surgeon, the elder Gross, the first American treatise on morbid anatomy.

Matthew Baillie's classical work on morbid anatomy led in England, as Bichat's did in France, in the early nineteenth century to the first fruitful combination of clinical and pathological studies, culminating in Richard Bright's "Reports of Medical Cases" published in 1827. From both sources sprang the new era which now arose in America, but it was from pupils of Louis, namely Gerhard, aided by Stillé, the younger Jackson, and Shattuck, that there came America's great contribution, resting upon combined clinical and pathological investigations, of the sharp and decisive distinction between typhus and typhoid fevers, following which Elisha Bartlett published the first modern systematic treatise on fevers based upon the new doctrines.

Results of the remarkable development of ophthalmology in England in the early nineteenth century by the work of Saunders, Adams, Travers, Lawrence, and Mackenzie were brought to the United States by Edward Delafield who with Rodgers founded the New York Eye and Ear Infirmary in 1820. As early as 1823 George Frick published in Baltimore the first original American treatise on the diseases of the eye.

The great reform in clinical teaching by Graves and Stokes in Dublin, transmitted to London by Robert Bentley Todd, had a marked influence in America, where Graves' "Clinical Lectures," the most famous ever published in English, had an enormous vogue at about the same period, when Sir Thomas Watson's "Practice" and C. J. B. Williams' "Principles of Medicine" were the admirable and favorite text-books.

While America has not produced a Harvey, a Sydenham or a John Hunter, one can recognize readily the lineage and the features of familiar types of English physicians and surgeons in conspicuous members of the medical profession in this country.

Benjamin Rush, the greatest historical figure in American medicine, has been called with singular inappropriateness "the American Sydenham." He belongs rather to a type not congenial to English soil, the eighteenth century systematists, of whom Cullen and Brown, whose disciple he was, are the chief, as well as the last British representatives. There was much more of that objective naturalistic study of disease, unhampered by tradition and dogma, which characterized Sydenham to be found in the works of Nathan Smith, Daniel Drake, and Jacob Bigelow. Physick, Mott, the Warrens, bear favorable comparison with their contemporaries in English surgery. Of the humanistic type of the lineage of Mead, Garth, and Arbuthnot were Hosack and his pupil Francis, interested in letters and natural history, prominent in social life, withal excellent teachers and physicians, worthy to have inherited the gold-headed cane had Matthew Baillie sent it across the Atlantic to New York. Bartlett, the elder Jackson, Alonzo Clark,

and the elder Flint belonged to the English type of sane, judicious, objective clinicians.

More picturesque and more distinctive of conditions then existing in America was the group of physicians and surgeons, of whom McDowell, Dudley, and Drake were the leaders, who lived in the early part of the nineteenth century on the frontier on or near the banks of the Ohio. While abreast in knowledge and skill with the best in contemporary medicine, they had all the indomitable pluck, the resourcefulness, and the native vigor of mind and body which characterized the pioneers who won the West.

There has been no analogy in America to the London hospital medical schools. These had their shortcomings as well as good features, but efforts to unify and to prove them do not encounter one of the main difficulties in improving medical education in America, where hospitals and medical schools originated and were developed apart from each other and the need of their affiliation or union meets serious obstacles. The admirable system of dressers and clinical clerks found in British hospitals was introduced first in America by Osler at The Johns Hopkins Hospital.

Nothing has been more remarkable during the last generation in American medicine than the establishment of independent institutions for medical research and the rapid improvement in medical education, so that our country in opportunities for the training of students and the promotion of knowledge compares favorably with those of Europe.

In these last remarks I have passed beyond the historical period set for this paper. It would transgress both this and the limits of space allowed were I to attempt to speak of the important influence upon American physiology of one of the glories of modern English medicine, its school of physiology, or of the great developments in the organization and administration of public health, in which England leads the world, although in this field America too has made valuable original contributions.

One of the results of the Great War has been to direct attention forcibly to the state of science, medicine, and public hygiene in the leading countries of the civilized world with the view of profiting by the lessons of the war and of readjustment to profoundly changed internal and international conditions. The minds of both the profession and the public have been awakened to the need of improvement in education and practice in science, medicine, and public health, of ampler provision for advancing and applying useful knowledge, and of establishing between countries recently associated in the war closer scientific relations and better reciprocal opportunities for graduate study. Considerations such as these make it well to recall the intimate association of British medicine and American medicine in the past and to look forward to a future of mutual helpfulness in which America may be able to repay a part of her debt to British medicine.

WILLIAM OSLER[1]

The death of Sir William Osler on December 29, 1919, in Oxford, England, has removed the most widely known, the most influential and the most beloved physician in the English-speaking world. Born in Ontario, Canada, in 1849, of a family marked by unusual mental gifts, and educated at Trinity College, Toronto, and in medicine at the University of Toronto and at McGill University, Montreal, where he was graduated M. D. in 1872, Osler, after two years of foreign professional study in London, Berlin and Vienna, was appointed in 1874 lecturer and soon afterward professor of the institutes of medicine at McGill University. His professional career of forty-five years was divided between ten years at McGill University (1874-1884), five years at the University of Pennsylvania (1884-1889), sixteen years at The Johns Hopkins University (1889-1905), and fourteen years at the University of Oxford (1905-1919). In each of these places he made an extraordinary and abiding impression upon both the medical profession and the public, so that Canada, the United States and England join in equal admiration and affection for the man and in mourning the loss of one whose fame is world-wide.

As a man of science and student of disease, Osler's type of mind was that of the naturalist, characterized by the faculty of close observation and clear and accurate description and interested especially in the natural history of disease. His early years in the profession, like those of so many other great clinicians, were devoted to the pursuit of morbid anatomy, in which he never lost interest. His great opportunity to establish his fame as a clinical teacher, author and consultant came with his call to The Johns Hopkins Hospital and University at the opening of the former in 1889. It was here that he made perhaps his greatest contribution to medicine, by the organization, development and conduct of a medical clinic along lines then new in this country and marking a great advance in American medical education.

Osler was the most inspiring and stimulating of teachers, exerting an unsurpassed personal influence upon students and assistants, who became and remained his ardent disciples. He imparted through precept and example high standards of professional conduct, habits of industry, thorough

[1] The Survey, N. Y., 1920, XLIII, 389.

study, the taking of careful notes of cases, interest in the history of medicine, a lofty conception of the duties of the physician to his colleague, his patients and the public.

The devotion of students was matched by the devotion of patients to Osler, the physician, who had in unusual degree the healing gift of bringing comfort, even joy at times, and of inspiring confidence. When the occasion was suitable the visit might be and often was brief, but the patient was lightened up by some droll, epigrammatic remark, some gay quip, some picturesque expression which remained treasured in the memory, but if need be none could be more sympathetic to patients and friends.

Osler was a prolific and important contributor to medical literature, over seven hundred thirty titles of books and articles being included in his bibliography. His Principles and Practice of Medicine has had an unequaled success as the standard text-book for students and physicians since the first edition was published in 1892, and like all of his writings possesses a charm of style rarely found in medical and scientific publications. The name of no medical author whose writings have not been also in the field of general literature is so well and favorably known to the general public and to the medical profession. This is due not solely to the often quoted and more often misquoted passage in his valedictory address at The Johns Hopkins University in 1905, but to the inherent interest, arresting quality and literary style of many of his general addresses.

Osler was a bibliographer, bibliophile, book-collector and medical historian of the first rank. As president of the Bibliographical Society of Great Britain and member of the celebrated Roxburgh Club, his services in this field were recognized. He was active in this country and in England in the development of medical libraries. A singular and much appreciated distinction for a medical man came to him in the last year of his life by election to the presidency of the British Classical Association, his presidential address last May in Oxford being perhaps the most remarkable of his many general addresses.

Osler was keenly alive to the implications and applications of modern medicine to the problems of society. Speaking with the authority and influence of a commanding reputation, with full knowledge and with rare gifts of vivid expression, he was a great force in arousing professional and public interest in such modern movements as the better care and control of tuberculosis, of typhoid fever, of malaria, of venereal diseases, and in general of improved public health administration. His name is identified especially with the launching of the anti-tuberculosis campaign as a national movement in America, and he continued his activity in this

field in Great Britain. He occupied an advanced progressive position and was active in his later years especially in the attack upon some of the most important problems of preventive medicine.

Such fullness of accomplishment could come only from a well ordered life and large capacity for work. Such a multitude of loyal friends could come only to one who was possessed of a real genius for friendship. Such varied achievements are an indication of unusual breadth of interests and of sympathy. To Osler nothing human was foreign. His home, both in Baltimore and in Oxford, was a center of hospitality. The influence of such a life and work is enduring.

VIVISECTION

OBJECTIONS TO THE ANTIVIVISECTION BILL NOW BEFORE THE SENATE OF THE UNITED STATES[1]

The provisions of Senate bill 1063 are so complicated and in several instances doubtful in their interpretation, and the objections to the bill are so numerous and their full presentation would require so much space that only some of the principal arguments against it can be considered within the compass of this succinct statement.

[1] The following statement has been prepared by the writer in order to meet the requests of several Senators of the United States and of physicians for objections to Senate bill 1063, which has been reported unanimously by the Committee on the District of Columbia. It is believed that many have been misled by efforts of advocates of the proposed legislation to make it appear that the bill is intended only to check alleged abuses of animal experimentation and not to interfere with its proper uses. A main purpose of this statement is to show the error of this assumption.[2] Much of the same ground has already been covered by others in various protests and publications.

J. Am. M. Ass., Chicago, 1898, XXX, 285-289.

[2] As a matter of fact no abuse of vivisection such as would justify any restrictive law whatever has been demonstrated in this country. The experience in England has shown the folly of the belief of some men of science and physicians that any compromise in this matter with antivivisectionists will check in the least their agitation of the subject. Upon this point I will quote, by permission, a few sentences from a private letter written by Michael Foster, who is recognized in this country as well as in Great Britain as the leader in his department of medical science. The letter was written to a prominent physiologist in this country: "I have always said and always shall say that the necessity of a restrictive law has never been shown. The English Commission failed to demonstrate any abuse such as could justify the measures adopted; and from what I know of America and Americans I am confident no such laws are needed with you. Indeed, my objections to the Act as a politician are quite as strong as my objections as a physiologist; the Act is stamped with that mark of bad statesmanship, *meddlesomeness*. . . . . If the time were to come over again, I should fight tooth and nail against any act at all, on the ground that all such *legislative restrictions are unnecessary*, that instances of cruelty, that is of heedless causing of pain on the part of physiologists are, to say the least, rare, and that public opinion aided by the ordinary law is quite sufficient to cope with such cases. (I of course assume that vivisection is absolutely necessary for the progress of physiology.) And, much as I hate public agitation, I should throw myself into agitating against such measures, sacrificing my little portion of present science for the sake of science to come. My advice to you is, accept no compromise whatever, refuse to admit for a moment the need of such a law, and fight against it everywhere, in the newspapers and on the platform, and if the situation demands it, even imitate your opponents and refuse a political vote to a candidate who will not pledge himself to vote against it. I do not think I can say anything stronger than this last. To repeal a law is a very different thing from opposing the making of one."

1. The bill is entitled "A bill for the further prevention of cruelty to animals in the District of Columbia." This title is misleading, as it does not indicate that the bill is intended solely for the restriction and regulation of experiments upon animals. The recommendation of the Commissioners of the District of Columbia in their report upon a bill of the same title and of similar contents in the 54th Congress (S. 1552) that the title be changed to read "A bill to regulate vivisection in the District of Columbia" was not adopted. It may well be questioned whether some who have signed petitions in favor of the bill have not been misled by the title as to the real contents of the bill.

2. The authorship of this bill is claimed by the antivivisection committee of the Washington Humane Society (Annual Report, 1895, p. 24). The attitude of this society toward experimentation upon animals is apparent in the report of its president for the year 1894, where he said: "The subject of vivisection (experiments upon animals) has been frequently before your executive committee during the past year, and but one sentiment has been expressed, viz., that of utter abhorrence and condemnation of the inhuman practice which, according to the oft expressed opinion of the best physicians and surgeons, is of no practical value to science or medicine." It should be borne in mind that this bill emanates wholly from those hostile to animal experimentation and who, as appears from the foregoing quotation, do not hesitate to misstate the opinion of the great body of the medical profession as to the value of animal experiments. No one familiar with the needs of scientific and practical medicine and of biological science and possessing skilled knowledge upon the subjects which the bill proposes to regulate has been consulted or had any hand in the drafting of the bill.

3. Medical and scientific men have never had adequate opportunity to present the arguments against this bill before the Committee on the District of Columbia, which has reported favorably upon it. At the hearing of a similar bill before this committee on April 17, 1896, Surgeon-General Sternberg said: "We did not know of this hearing until today, and were compelled to come here without any previous preparation." Surely a bill which is of far more than local interest, as appears from the numerous communications regarding it from all parts of the country, and which in its direct and remote bearings, in the opinion of enlightened physicians and scientists, vitally concerns the future progress of medicine and biological science in this country, never should have been reported by the committee without thorough investigation as to its necessity and its effects and without full opportunity, granted not only to physicians of the District of Columbia but to others, to prepare and submit arguments against it. An hour's time granted to a few hastily summoned physicians and scientific men of the

District, who came without preparation, did not afford the requisite opportunity to present adequately the objections to the bill.

4. Any one who is at all familiar with the writings and the propaganda of the antivivisectionists knows that their ultimate aim is to abolish animal experimentation altogether. They demand only such measure of restrictive legislation in the present bill as they think they may be able to secure at the present time. Concession to these demands will not check their agitation of the subject and their efforts to secure more stringent laws, as has been abundantly demonstrated in England, where some medical and scientific men unwisely thought that by yielding to relatively moderative demands for legislation, further agitation of the subject would end. On the contrary, bills for the total abolition of experiments upon animals have been introduced into the British parliament since the passage of a bill similar to Senate bill 1063.

5. Although it is contended by advocates of the bill that it will not interfere with the proper uses of animal experimentation, it is to be noted that the remarks of these advocates at the hearing before the committee and the favorable report of Senator Gallinger are occupied largely with the presentation of the stock arguments of antivivisectionists against the value and the justification of experimentation upon animals. The most important of these arguments are the following: *a.* That medical and scientific men are divided in opinion upon this subject; *b*, that experiments upon animals have yielded results of little or no value to medicine or science; *c*, that such experiments are conducted with wanton cruelty and are brutalizing to those who witness or practise them. These arguments have been refuted many times. It would require a voluminous treatise to present the evidence relating to them adequately. It must suffice to mention only a few points.

a. It is untrue that there is any material division of opinion among well informed medical or scientific men as to the necessity and value of animal experiments. The names of a very few more or less prominent physicians, in no instance themselves scientific experimenters, are constantly cited, in some cases incorrectly or incompletely, by antivivisectionists in support of their position. Lists of other physicians collected by antivivisectionists as opponents of animal experimentation will not in general bear scrutiny as to the professional standing or scientific attainments of the majority of those whose names are given. The incorrectness of the statement of antivivisectionists here challenged must be apparent from the fact that whereas not a single medical or scientific society is known to have favored this bill, at least a hundred such societies, which assuredly represent the great body of physicians and scientists of this country have protested against its passage. These societies represent the rank and file of the medical profession and not exclu-

sively "ultra-scientists," as has been claimed. It is therefore unhesitatingly asserted that the medical profession and scientists, so far as their opinion receives authoritative utterance, are overwhelmingly opposed to this bill.

b. The constantly reiterated statement of antivivisectionists that animal experimentation has been of little or no value to medicine, can be the result only of ignorance or of wilful misrepresentation. It would be surprising, indeed, if the experimental method, which is essential to every other science and has been the great instrument of modern scientific progress, should have no value for medical science. Surely this is a matter concerning which the judgment of the great body of enlightened physicians should be decisive. The progress of medicine from the time of the discovery of the circulation of the blood, which was based upon the results of animal experimentation, up to the present time, has rested in a very large measure upon discoveries which could have been made only by experiments upon animals. It must suffice here to cite only a few illustrations of practical value of animal experimentation, such as the establishment of the germ doctrine of infectious disease, the introduction of antiseptic surgery, the prevention of childbed fever, the antitoxin treatment of diphtheria and other diseases, the prevention of rabies by Pasteur's method of inoculation, the successful treatment of myxoedema and cretinism by thyroid extracts. Countless thousands of human lives have been saved and will continue to be saved by methods of prevention and treatment of disease, which are derived from the results of animal experimentation. Recent years have been particularly fruitful in discoveries of the highest importance resulting from animal experimentation. Never was there so little justification to hamper in any way the work of those engaged in searching by experiment, for means of preventing and curing disease.

c. The claim of antivivisectionists that scientific experimentation on animals brutalizes those who witness and practise it, is an insult, without shadow of foundation, to a class of scientific workers unselfishly devoted to the investigation of problems of the highest importance to the welfare of mankind.

There is no part of the campaign of the antivivisectionists conducted with such gross misrepresentation of the facts as that intended to make the public believe that scientific experiments upon animals are conducted cruelly, that is, with the infliction of needless pain. A large part of antivivisection literature consists of leaflets and broadsides scattered broadcast among the public, containing pictures of animals and descriptions of experiments, which are in general so erroneous or garbled or unintelligible to most of those who read them, that they convey utterly false impressions. It is repugnant to the spirit of medicine and of science to resort to similar methods in order to

counteract the deplorable effects of these emotional and misleading appeals of antivivisectionists to the general public. The charge of any considerable abuse of the practice of animal experimentation on the ground of cruelty, especially in this country, has been abundantly refuted by articles in journals and other publications, which unfortunately rarely come to the notice of the great majority of those who receive the gruesome circulars of antivivisectionists. Whenever the conditions of the experiment permit, and this is in the great majority of painful vivisectional experiments, all trained experimenters place the animal during the operation completely under the influence of anaesthetics. There is no evidence that there exists today in any properly conducted laboratory in this country any abuse of vivisection on this score.

6. The advocates of this bill have not been able to point to a single authenticated instance of the abuse of animal experimentation in the District of Columbia. The same inability to specify instances of abuse in Massachusetts was demonstrated in the recent hearing before the committee of the legislature of that state relating to a bill to control animal experimentation. Notwithstanding most violent efforts on the part of English antivivisectionists to excite popular feeling by charges of wanton cruelty against scientific experimenters upon animals, the royal commission appointed to inquire into the matter "entirely acquitted English physiologists of the charge of cruelty." The committee recommending Senate bill 1063 has attempted no similar inquiry for this country, but it can be confidently predicted that similar charges made in the most reckless and wanton manner against American physiologists would be found to be equally unfounded.

It is not true that secrecy is practised in the conduct of such experiments. In scientific publications these experiments are described in detail. There is no effort made to prevent properly qualified medical and scientific men from witnessing these experiments. For manifest reasons it would be as improper and undesirable to throw open such experiments to the inspection of those without any training or competence to judge of their character and value, as it would be to give similar publicity to surgical operations. In the absence of any demonstration of abuse of the practice of animal experimentation in the District of Columbia, this bill is unnecessary.

7. It is well understood that the organization and strenuous efforts of antivivisectionists to secure Congressional legislation upon this subject is not so much to check the abuses in the District of Columbia, where in fact they do not exist, as to influence legislation in the various states of the Union. Although they have made repeated attempts to secure legislation, generally far less stringent than that contemplated in this bill, in different states, they have hitherto been unsuccessful. Wherever full and fair opportunity has been given to physicians and scientific men, they have had no difficulty in

demonstrating to the satisfaction of committees of our state legislatures the objections to any such legislation. We would call particular attention to the convincing arguments urged successfully against a much milder bill recently introduced in the legislature of Massachusetts, a state in which the antivivisectionist agitation has been particularly active.

8. The experience with legislation, similar in character to this bill but surrounded with more effective safeguards against interference with scientific experimentation in England, has been most unfortunate in its influence upon the advancement of medical science in that country. Many scientific workers in England, including Lord Lister, one of the greatest benefactors of the human race through his introduction of antiseptic surgery, have preferred to leave their country and conduct their experiments in continental laboratories, rather than submit to the vexatious restrictions upon their work. Earnest appeals have been sent by eminent men of science in England to physicians in this country not to repeat their mistake of yielding to the demands of antivivisectionists in this matter.

9. The District of Columbia already has an unusually comprehensive and effective law for the prevention of cruelty to animals, and there is no need of further legislation in the direction contemplated in this bill. Only properly conducted scientific experiments under proper authority are now allowed. Those who conduct experiments upon animals are no less subject to the provisions of the existing law than other members of the community. If they can be convicted of cruelty in the practice of their experiments, the present law provides adequately for their punishment. The antivivisectionists complain that they are unable to secure convictions of experimenters upon animals under the present law. If so, it is because they can furnish no evidence of cruelty in the conduct of the experiments convincing to a court of justice. Their demand that the doors of laboratories shall be thrown wide open to agents of their societies in order to procure evidence, would lead to a system of outrageous espionage utterly foreign to our system of government, and degrading and intolerable to the scientific men in charge of the laboratories.

10. This bill is unanimously opposed by the great scientific and medical bodies of this country, national, state and local, who recognize in its provisions a blow to freedom of investigation and to the advancement of medicine and biology. Among the many more societies which have protested against this bill may be mentioned The National Academy of Sciences, The American Association for the Advancement of Science, The Society for the Promotion of Agricultural Science, The American Medical Association, The Congress of American Physicians and Surgeons, The American Public Health Association, The United States Veterinary Medical Association, The Association of American Physicans, The American Surgical Association,

The Association of American Medical Colleges, The New York State Medical Society and Association, The Medical and Chirurgical Faculty of the State of Maryland, and other state societies, the New York Academy of Medicine, etc. The assumption that the protests of these societies have been made in ignorance of the provisions of the bill is absurd. It would be incomprehensible if Congress should ignore or disregard the united voice of these great organizations in a matter which directly concerns the welfare of medicine and biological science.

11. Although there is abundant evidence in the report recommending this bill that the real sentiments of its advocates are hostile to scientific experiments upon animals, it is nevertheless asserted by them that the bill, if it should become law, would not in fact interfere with the proper uses of animal experimentation for scientific investigation and study. Such an assertion can be made only by those unfamiliar with the needs of medical and biological science and with the purposes of experimentation upon animals, or else ignorant of the provisions of the bill. To take up in detail all the provisions of the bill and to point out fully the manifold ways in which they would interfere with proper and legitimate uses of animal experimentation, would require more time and space than can here be given. This work has been done in part, but only in relatively small part by others, notably by the Secretary of Agriculture, the Hon. James Wilson, and the former Acting Secretary of Agriculture, Dr. Charles W. Dabney, Jr., in their published letters addressed respectively to the Hon. Redfield Proctor and the Hon. James McMillan. It must suffice here to indicate only a few of the ways in which this bill would prove injurious to medicine and biology, but enough will be shown to demonstrate its fatally defective character.

A. The bill provides (Sec. 2, *b*,) that "The experiment must be performed by a person holding such license from the Commissioners of the District of Columbia as in this act mentioned, or, by a duly authorized officer of the Government of the United States, or of the District of Columbia." It further provides (Sec. 3) that the Commissioners of the District may require the place in which any experiment is made by a licensee to be registered in such manner as they may direct and that every place for the performance of experiments for purposes of instruction shall be approved by the said commissioners and registered in such manner as they may direct. It also provides (Sec. 5) "That the Commissioners of the District may direct any person performing experiments under this act from time to time to make reports to them of the methods employed and the results of such experiments, in such form and with such details as the said commissioners may require," and again in Sec. 7 the bill provides that "The Commissioners of the District may at any time disallow or suspend any certificate given under this section."

It is evident that this bill gives uncontrolled discretion to the Commissioners of the District of Columbia in the granting of all licenses permitting experiments upon animals. They may if they choose, grant all applications for license or they may refuse all such applications and thereby prohibit all animal experimentation in the District, except that conducted by officers of the Government of the United States or of the District of Columbia. Experiments by the latter officers, as well as by licensees, they may hamper so as to make the privilege of experimentation practically useless, by demands for reports upon the methods and results of experiments at any stage of the experimental investigation as often and with as much detail and in such form as they choose. An unfinished experimental research can be interrupted or brought to an end at any time by suspension of the license in the discretion of the commissioners. No provision is made for any hearing by the applicant or the licensee. There is no appeal from the decision of the commissioners. They are the sole arbiters in the matter. They are made the dictators of the medical profession by this bill in matters requiring expert knowledge and sympathy with the needs of medical science.

No one can foretell in what manner the District Commissioners would exercise the arbitrary powers conferred upon them by this bill. It is certain that if they exercised them so as to meet the approval of those from whom this bill emanates and the antivivisectionists in general, who are its advocates, they would antagonize the medical profession and scientists and would inflict serious injury upon human and veterinary medical science and upon biology. On the other hand, if they administered the law so as to meet, so far as the bill permits, the wishes of the physicians and scientific men, they would as surely antagonize the great majority of the advocates of the bill, who would continue their agitation and endeavor to secure still more prohibitory legislation.

Among the many objections to this bill there is none more fatal in the principle involved or likely to be more so in the practical working of the proposed legislation than that this bill places in the hands of a body of men, who need not be and are not likely to be physicians or men of science, arbitrary powers, requiring skilled knowledge in their use, concerning matters of the highest importance to medicine and biological science and to the welfare of mankind and of animals.

B. The bill provides (Sec. 6) "That the President of the United States shall cause all places where experiments on living vertebrate animals are carried on, in the District of Columbia, to be, from time to time, visited and inspected without previous notice for the purpose of securing compliance with the provisions of this act; and to that end shall appoint four

inspectors, who shall serve without compensation, and who shall have authority to visit and inspect the places aforesaid, and who shall report to the President of the United States from time to time the results of their observations therein, which shall be made public by him."

It will be observed that this section makes no provision that the inspectors called upon to scrutinize and report upon the experimental work of physicians and scientific men shall possess any special qualifications for such remarkable and responsible functions. Can it be assumed that the President will appoint only those who possess the requisite qualifications and where will he find them? Our universities and medical colleges and hospitals and government laboratories search the country over to find men fitted to conduct the experimental investigations which this bill would regulate and control and they have difficulty in finding those with requisite training, scientific knowledge and special skill. And now this bill provides that over such men as these shall be placed inspectors to determine whether their experiments are performed in the proper manner and upon proper animals and for proper purposes and to make reports upon their experiments, which reports shall be made public.

The character of the inspection desired by the advocates of this bill is made sufficiently evident by the provisions of the original bill (S. 1552) that the Commissioners of the District "shall appoint and authorize an agent of the Washington Humane Society to make such inspection." The attitude of this society toward animal experimentation is clear from the extract from one of its reports already cited (p. 456). It certainly may be reasonably assumed that this society and antivivisectionists in general will claim and secure representation among the inspectors provided for in this bill. Nor is it unreasonable to suppose that they may even control the majority of the inspectors. In larger or smaller part, therefore, the inspection will doubtless be by men or possibly women, not only without special scientific knowledge but actually opposed to experimental medical or biological science. It would be entirely in the power of such inspectors to render the conditions for experimental work such that no one would care to undertake it.

It is a libel upon common sense to assert, as is insistently done by the advocates of this bill, that the objection of experimenters to any such system of inspection as that provided for in this act, is due to their fear of exposure of wanton cruelties practiced by them in the secrecy of the laboratories. As a matter of fact, no secrecy surrounds the practice of animal experimentation, and any properly qualified person has free access to the laboratories where such experiments are made.

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C. The hardship which would be inflicted upon those engaged in experimental research by the provisions of the bill that at any stage of their investigations they may be called upon to furnish detailed reports of the methods and results of their work and that those, with probably no comprehension of the nature and purposes of the experiments, shall make reports thereupon. which shall be published, can be fully appreciated only by those who are acquainted with the conditions under which scientific inquiry is prosecuted. There are many important scientific investigations which would probably not be undertaken at all under any such vexatious conditions as these. These provisions, as well as others in the bill, can be utilized constantly to harass experimenters in case the law should be administered, as is not at all improbable, by those unfriendly to experimental inquiries in medicine and biology.

D. The bill prohibits important and necessary experiments and surrounds the performance of others with such restrictions as virtually to prohibit them. Exactly how far this prohibition extends cannot be determined without an interpretation by the courts of certain doubtful provisions of the bill, nor can any one foresee what new kinds of experiment, not now provided for in the bill, the future progress of medicine and biology will require.

The bill provides (Sec. 2, *a*) that "The experiment must be performed with a view to the advancement by new discovery of physiological knowledge, or of knowledge which will be useful for saving or prolonging life or alleviating suffering." If this provision be interpreted according to the explicit language used, and it may be presumed that the courts would so interpret it, no experiment can be made (except demonstrations for lectures provided elsewhere in the bill) which is not for the advancement of knowledge *by new discovery,* and this knowledge must be one of two kinds, either physiological or such as will be useful for saving or prolonging life or alleviating suffering.

The term "physiological" is used both in a broad and narrow sense, and it cannot be confidently predicted how the courts might interpret it. To compel an experimenter to pause before each experiment which he is about to make and consider whether he can demonstrate to the satisfaction of a court that the experiment, if not for the advancement of physiological knowledge, is for the advancement *by new discovery* of knowledge, which can be utilized in saving or prolonging life, or alleviating suffering, would not be conducive to progress in the very kind of knowledge specified. The history of scientific discoveries in medicine, no less than in other fields, demonstrates that experiments undertaken without any thought of practical application, and yielding results which appear at the time to be devoid of all practical utility, have often laid the foundations of knowledge of the highest importance to mankind.

Two valuable lines of experimentation at once suggest themselves as forbidden by the words of this section, viz., experiments to confirm results obtained by others, and experiments to acquire manual skill in performing surgical operations. The first of these restrictions was pointed out by Dr. Chas. W. Dabney, Jr., former Acting Secretary of Agriculture. Although the report upon the bill states that "the bill does not bear this limited construction," it is difficult to see how the plain language can be construed otherwise, and, if it was not the intention to prohibit confirmatory experiments, the question arises why those who drafted Senate bill 1063, in copying this section from the British law, omitted the paragraph in the latter which expressly provides for experiments made "for the purpose of testing a particular former discovery alleged to have been made." Certainly the framers of the British law could not have considered that experiments confirmatory of alleged discoveries were already provided for by the section in question or they would not have added the paragraph omitted from the Senate bill. There is no other natural inference than that it was deliberately intended to forbid confirmatory experiments.

Experiments upon animals in order to acquire manual skill in performing surgical operations, certainly are not experiments for the advancement of knowledge *by new discovery*. Whether it was intended to prohibit such experiments is not clear. In Sec. 2, *c*, it reads "nor in tests of surgical procedure need animals be kept completely anaesthetized during the process of recovery." There is nothing, however, here or elsewhere in the bill to indicate that these tests are to form any exception to the general requirement that, save demonstrative experiments for lectures, all permissible experiments must be for the advancement of knowledge *by new discovery*. If, as seems to be the natural interpretation of the language of the bill, surgeons are not to be permitted to perfect themselves in methods of operating by experiments upon animals, this prohibition can be characterized as nothing less than inhuman. The only alternative is to make a human being instead of one of the lower animals the subject of experiment. There are many operations which a surgeon may wish first to try upon an animal before attempting them upon a human being. An eminent surgeon has said that a surgeon should not perform the operation for circular suture of the intestine and for intestinal anastomosis upon man without first practising it upon animals.

The bill provides (Sec. 2, *c*,) that "The animal must, during the whole of the experiment, be completely under the influence of ether or chloroform," excepting in inoculation experiments, tests of drugs or medicines, and during recovery from surgical operations. It is absurd to limit the choice of anaesthetics to two. There are other anaesthetics which produce equal

insensibility to pain, and any one at all acquainted with physiological experiments, knows that there are experiments in which it is safer, better, and sometimes for the purposes of the experiment necessary, to produce anaesthesia in other ways than in the only two permitted by this bill.

The absurdity of the claim that this bill is simply restrictive and regulative, and not prohibitive of experiments upon animals, can be shown in many if its provisions, and especially by that which forbids the survival of the animal after an operation unless kept continuously under the influence of ether or chloroform. The only exceptions to this provision are inoculation experiments, tests of drugs or medicines and tests of surgical procedure. The experiments which are prohibited by this provision are so many that they cannot even be enumerated within the compass of this statement. All physiological and pathological experiments where the ends of the experiment can be attained only by observation of the animal for days or weeks after some operation, or after the administration (save by inoculation) of anything except drugs or medicines which may give pain, are prohibited by this bill, for it is impracticable to keep animals during such periods of time continuously anaesthetized. Such important experiments as those which have shed light upon the functions of the stomach by gastric fistula, or of the heart by the experimental production of valvular lesions, or of the central nervous system, kidneys, and indeed most of the organs of the body by observations extending over some length of time after an experiment, are all prohibited by the conditions of experimentation imposed by this bill. All experiments are prohibited in which anything, except drugs or medicines, is simply fed or introduced into the stomach in case the experiment is calculated to give pain to the animal and extends beyond the limited period in which it is practicable to keep the animal under ether or chloroform.

It may well be questioned whether it was intended to forbid the large class of important and necessary experiments of the characters described. If it was not, then the bill is so loosely drawn that it should never pass in its present form. If it was intended to exclude all of these experiments, then the blow which its enactment would inflict upon biological and medical science is simply brutal.

There are other kinds of valuable experiments which are prohibited by this bill besides those specified, but enough has been said to show the error of the assertion made in the report recommending it that "the bill is restrictive, not prohibitive," and to demonstrate that among the prohibited experiments are many of the highest scientific and practical value, including many which involve far less suffering to the animal than some which are permitted.

E. The bill provides (Sec. 4) "That a license shall not be granted to any person under the age of twenty-five years unless he be a graduate from a medical college, duly authorized to practise medicine in the District of Columbia." There are graduates of zoology and other departments of Biology under 25 years of age eminently qualified by their training for investigations involving experimentation upon animals. Concerning the effect of this provision upon the work of the Bureau of Animal Industry Dr. Dabney, in the letter already cited says: "It would at once stop some of the experiments now in progress, and if it had been enforced in the past years would have prevented a large proportion of our scientific employes from doing this class of work."

F. The greater part of the investigations requiring animal experimentation in the District of Columbia are conducted in the Bureau of Animal Industry under the Department of Agriculture. This bill takes the scientific work of a Department of the General Government to a considerable extent out of the hands of the Secretary of Agriculture, and places it to a corresponding extent under the control of officials of the District of Columbia, and that too for matters which concern the agricultural interests of the entire country and only in relatively small measure concern the District of Columbia. The bill accomplishes this by providing that the Commissioners of the District may direct any person performing experiments to report to them from time to time the methods and results of their experiments in such form and with such detail as the commissioners may require. It will be observed that it is not the Secretary of Agriculture who is to be called upon to report, but it is his subordinates. The bill further provides that if any of five kinds of animal (cat, dog, ass, mule, horse), are used for the experiment, a special certificate setting forth certain facts must be procured. The bill is singularly indefinite as to these certificates, especially not stating by whom they are to be given, or to whom application for them is to be made. If, as is not improbable, it was the intention that these certificates should be granted by the commissioners, then the scientific work of the Bureau of Animal Industry is placed practically under the direction of these District officials, for no provision of the bill exempts officers of the government from the necessity of procuring these certificates, as is the case with licenses.

No attempt has been made in this statement to present a complete analysis of Senate bill 1063 and to point out all of its objectionable provisions or even to exhaust the objections to such as have been considered. No such complete analysis is necessary in order to prove the error of statements in the report recommending it that it is "reasonable and wise," "restrictive and not prohibitive," and permissive of all "useful investigations." It may

be that the committee recommending the bill believed it to possess the moderate and reasonable character claimed for it. The defects of the bill are evident enough to those who are familiar with the requirements of modern medicine, in its scientific and practical aspects, and with the needs of biological science. So evident indeed are they that it has generally seemed unnecessary to medical and scientific societies and individuals, who have protested in hundreds against the passage of the bill, to do more than emphasize on the one hand the great benefits derived from animal experimentation and on the other the restrictive and prohibitive features of the bill.

Apparently so convinced have many of the advocates of the bill been of its moderation, that they have assumed that these protests have been made in ignorance of the provisions of the bill, a most unwarranted and gratuitous assumption. It is not to be expected that any considerable number of the committee to which the bill was referred should possess that technical, expert knowledge essential for an intelligent judgment as to the effects of a complicated bill which prescribes by whom, and for what purposes, and upon what animals, and in what manner, scientific experiments shall be performed.

It surely could not have been the intention of the Senate Committee recommending this bill to inflict such serious injury upon medicine and science as, in the opinion of those who by their training, occupation and special knowledge of the subject are most competent to judge of its workings, it certainly would inflict.

ARGUMENT AGAINST SENATE BILL 34, FIFTY-SIXTH CONGRESS, FIRST SESSION, GENERALLY KNOWN AS THE "ANTIVIVISECTION BILL"[1]

It is most significant that, notwithstanding the chairman's suggestion at the outset of this hearing, that time might be saved by the omission of a detailed presentation of the benefits of vivisection, inasmuch as this bill, it was said, is not intended to hinder useful experimentation on animals, so large a part of the remarks of the previous speakers on both sides has been devoted to a discussion of this very subject. In truth, it could not be other-

[1] On February 21, 1900, the Senate Committee on the District of Columbia, with Senator Gallinger in the chair, gave to advocates and opponents of the "antivivisection bill" a public hearing, at which I presented in its main features the following argument. After this hearing, on March 9, 1900, an amended or substitute bill, still designated S. Bill 34, was printed for the committee. The principal changes from the original bill made by this substitute are as follows: 1. The title now reads: "A bill for the regulation of vivisection in the District of Columbia." 2. The restrictions apply for the most part only to experiments on warm-blooded animals instead of to those on all vertebrates. 3. Experiments to acquire "surgical experience" are now allowed. 4. The class of officers of the United States Government who may experiment without a license from the District Commissioners is defined. 5. The use of other anaesthetics besides ether and chloroform is allowed. 6. "Tests of foods" and "experiments relating to the communicability of disease" are added to the small list of experiments in which the animal need not be anaesthetized nor killed afterward. 7. The permission to illustrate lectures in hospitals by animal experiments is withdrawn. 8. The requirements for special certificates—distinct from licenses—to experiment on a dog, or cat, on a horse, ass, or mule, are omitted. 9. The acquirement of physiologic knowledge is omitted as a permissible purpose of demonstrative experiments in lectures to medical students. 10. Licenses may be granted to any qualified person over 21 years of age. 11. All places where experiments are performed must be approved and registered. 12. The reports on the methods, the number and species of animals used, and the results of experiments must be made on January 1 and July 1, to the Commissioners, a delay not exceeding six months for alleged unfinished experiments being granted. These reports must be published.

The only concessions of importance made by these changes relate to the exclusion of cold-blooded animals, the omission of two classes of special certificates, and a wider choice in the selection of anaesthetics. In several particulars the restrictions are made more severe, and in general the worst features of the bill remain unchanged.

In the following argument I have taken into consideration the changes made by the substitute bill, so that in some respects it differs from that presented at the public hearing on February 21.

J. Am. M. Ass., Chicago, 1900, XXXIV, 1242-1244; 1322-1327.

wise, for the principal line of division between the advocates and the opponents of this bill is marked by their opinions on the utility of animal experimentation. However much the advocates of the bill may assert that its enactment will not interfere with the proper uses of such experimentation and is designed only to check abuses, it is to be noted that the main part of their argument is an attack on the practically unanimous opinion of well-informed scientific and medical men that experimentation on animals is essential to the advancement of physiology and medicine and has conferred inestimable benefits on mankind. Nor is it surprising that antivivisectionists should cling tenaciously to this position, indefensible as it has become, for it is apparent that those who are convinced of the great value of experiments on animals, to science and humanity, will hesitate long before approving any legislation likely to check the progress of scientific and practical medicine.

Men who would hold this conviction are not likely to give any favorable consideration to legislative proposals intended to restrict the use of an important method of scientific research until it has been demonstrated that its possible abuses are in fact common and great and uncontrollable by existing legislation and by public opinion, including that of the medical profession. They will inquire carefully whether the proposed legislation will actually reach the abuses, if these should be shown to exist, and, even if it should do so, whether it may not do more harm than good by obstacles put in the way of proper and useful experimentation. They may even pause to consider whether there may not be some inequality in singling out for penal legislation the infliction of pain on the lower animals for the purposes of biological and medical science, while leaving untouched an immeasurably greater amount of suffering inflicted on animals by man for his food, his adornment, his amusement and other objects which it would be difficult to show are higher and more worthy than those of the physiologist and the physician.

I have sometimes wondered at the attitude of mind of professed humanitarians who are so eager to collect all testimony, even the most obscure, trivial and discredited, which may make the public believe that some new remedy or improved method of treatment, such as antitoxin or antiseptic surgery, demonstrated to the satisfaction of most physicians to be a priceless boon in saving human lives and relieveing suffering, is of no value whatever. Still, it must be admitted that for the sake of their cause the antivivisectionists do well to ransack, as they do, medical journals and books for statements which may minimize the effects on the public of the constantly increasing evidences of the benefits to mankind, and indeed to animals also, derived from the results of animal experimentation. Of course, they can find state-

ments in contradiction of almost any generally accepted truth in medicine, as they could in any science, but in view of the proverbial disagreements of doctors, and of the little interest which most of those who apply scientific discoveries have in informing themselves of the sources of their knowledge, it is on the whole surprising that the familiar list of medical quotations, which has so long done duty in antivivisectionist's publications in opposition to the great value of experimentation on animals, should be so meager, in contrast with the enormous preponderance of testimony on the other side, and should be representative of so few names of eminence, I believe scarcely one which would be generally recognized by physicians as of a writer especially competent to speak on this subject, however distinguished in other lines. So rapid have been the advances of medicine and surgery in recent years, attributable to knowledge gained from experiments on animals, that it may be urged that an adverse opinion expressed even a decade ago would be reversed today, but I am not sure that the exceptional physician who was blind to this source of light at any time since the days of Harvey would see it today, notwithstanding its greatly increased brilliancy.

It has seemed to me appropriate to say this much in explanation of the emphasis laid by previous speakers on the subject of the utility of vivisection, but it is not my purpose to set forth the actual benefits secured by this method of investigation. This has already been done by Dr. W. W. Keen, Dr. H. A. Hare and other speakers, although none of these gentlemen would claim that he had been able to present a tithe of the debt which physiology and the healing art owe to the results of animal experimentation. Those of the public who wish fuller knowledge on this subject, and who care to read a larger part of the evidence which has led the vast majority of the most humane of professions to approve of vivisection I would refer to the recent book by Stephen Paget, F. R. C. S. Eng.—"Experiments on Animals. With an Introduction by Lord Lister." (London, 1900.)

One other point before I pass to the examination of the bill before us: I shall be so bold as to remind the distinguished lawyers on the other side, who have today so recklessly charged those with cruelty who experiment on animals, that the legal definition of cruelty given by the "Century Dictionary" is: "An act inflicting severe pain and done with wilfulness and malice." Judge Hoar, in a Massachusetts case, says: "Pain inflicted for a lawful purpose and with a justifiable intent, though severe, does not come within the statute meaning of cruelty." (James M. Beck, of the Philadelphia Bar: The Legal Aspects of Vivisection, Medical News, 1890, lvi, p. 280.) While I do not deny that cruel experiments, in the sense of heedless causing of pain, have been made, I am convinced that they are very exceptional. The accusation of cruelty, when made, as it often is by our opponents, and has

been made today, against experimenters on animals, as a class, is false and slanderous. In no other group of cases in which animals are made to suffer for the benefit of man is equal care exercised to avoid the infliction of needless pain. The difference is simply immeasurable between the solicitude in this regard and the quantity of actual suffering inflicted in scientific experiments on the one hand and, on the other, the heedlessness and the vast unnecessary amount of pain inflicted in the slaughtering, the sexual mutilation, the transportation, the poisoning, and the hunting, trapping and shooting of animals. On the one side hundreds, on the other millions of animals are concerned annually; on the one side a serious purpose to advance scientific knowledge and directly promote the healing art, on the other the satisfaction of appetite, often in a luxurious way, the exercise of some convenience or economy, the gratification of the desire for sport or of some whim; on the one side insensibility to pain secured by anaesthetics, as a rule, whenever practicable, and this is so in the great majority of cases, on the other very little regard to the avoidance or reduction of unnecessary suffering.

In speaking on a former occasion of the self-sacrifice and benevolence of the members of the medical profession, your chairman justly said that no legislation should be enacted that would unnecessarily hamper them in their pursuit of useful knowledge, and he has today very properly asked that it shall be pointed out in what way the proposed legislation would interfere with useful experiments, with such experiments, for example, as those cited by Dr. Keen, Dr. Hare, and other speakers. It is asserted with much insistence by its advocates, that this bill is "moderate," "reasonable and wise," "restrictive and not prohibitive," "not an antivivisection measure," "does not impede in any way the proper use of animal experimentation," "goes to the fartherest extreme of concession in the anxiety of its framers to yield to the wishes of scientific men so far as may be consistent with the principle of legal supervision," "concedes everything of utility." It is my especial purpose to examine these contentions in the light of the specific provisions of the bill, and I hope to be able to demonstrate to the satisfaction of the members of this committee that this bill is unnecessary, is vague and contradictory in some of its provisions, places the entire control of a scientific method of investigation in the hands of laymen not qualified to exercise such arbitrary powers, absolutely prohibits important and useful experiments and can be administered so as to prohibit all experiments, surrounds the practice of animal experimentation with absurd and vexatious restrictions, and, if enacted into law, would inflict serious injury on the progress of science and medicine.

I have already traversed much of this ground in my letter to a former member of this committee, the Hon. Arthur P. Gorman, printed as Senate

Document No. 104, 55th Congress, Second Session, (also in "The Journal," Feb. 15, 1898, p. 285), which I beg leave to offer for your consideration. I would also call your attention to other documents of similar purport, especially the letter of the Secretary of Agriculture, the Hon. James Wilson, printed as Senate Document No. 112, 55th Congress, First Session, that of Dr. Dabney, President of the University of Tennessee and former Acting Secretary of Agriculture, to the Chairman of the Committee on the District of Columbia, the Hon. James McMillan, and the recent letter of Dr. Woodward ("The Journal," February 10, p. 381), the Health Officer of the District of Columbia, to the Commissioners of the District.

As Dr. Salmon has pointed out at this hearing, and as Dr. Woodward has shown in his letter, just referred to, there is no need for additional legislation restricting the practice of animal experimentation in the District of Columbia. The existing law permits only "properly conducted scientific experiments or investigations, which experiments shall be performed only under the authority of the faculty of some regularly incorporated medical college, university or scientific society." The bill before us attempts to define with considerable detail, what constitutes a properly conducted experiment, and with what success I propose presently to show. A commission of scientific experts would find it difficult, if not impossible, to prescribe with similar detail the proper conduct of all scientific experiments on animals, and most assuredly such experts have had no hand in the drafting of this bill. If it be asked, Who shall be the judge of the proper conduct of the experiments? I reply: In the first instance the scientific men who act "under the authority of the faculty of some regularly incorporated medical college, university or scientific society," then the governing bodies of these incorporated institutions, and in the final decision the courts, as provided by the existing law, and most certainly not, as proposed in this bill, the Commissioners of the District of Columbia, who have no special qualifications to judge of such a matter.

There is not a particle of evidence that abuse of animal experimentation has ever existed or is likely to arise in the District of Columbia or, if it should occur, of the inability of the present law to cope with it. I know that one can conjure up in his imagination horrible possibilities, to meet which no law would seem too severe, and that charges of atrocious cruelty are spread before the public by antivivisectionists with reckless disregard of the facts, but we court the fullest investigation, by any impartial body of men, of the actual conditions of animal experimentation in this District and in this country, and we are confident that such investigation would show the groundlessness of these imaginings and the wantonness of these accusations. Before any such legislation as that embodied in this bill is

recommended, in the face of the unanimous protests of the scientific and medical societies and of the great body of physicians of this country, it surely seems incumbent upon your honorable body to make such an official investigation as we have often asked for.

Although we are here to discuss this particular bill, and not the general subject of legislative restriction of experimentation on animals, I am free to confess that I consider the public opinion of the medical profession, which is as sensitive to actual cruelty as that of any "humane society," an efficient safeguard in this matter, and amply sufficient when combined, as it is here, with an adequate law. As has been said: "Probably the members of anti-vivisectionists societies do not believe that there is any such professional public opinion; but there is, and it is an effectual, though quiet, check on the few who need it. But if any influence from the outside could injure it, it would be the constant ignoring and denying of its existence. It is not generally found an incentive to honesty to tell a man: "you would be a thief if you could, and therefore I shall keep all my goods under lock and key when you are about, and have my eye on you when you don't expect it." Weak honesty grows strong when leaned upon; but even strong humanity, insulted and disbelieved in, may hear itself called callousness until it ceases to care for the charge. (Physiological Cruelty: or, Fact v. Fancy. An inquiry into the Vivisection Question. By Philanthropos. P. 100. London. 1883. This is the best book with which I am acquainted on the general subject of vivisection.)

If all that could be said against the legislation proposed in this bill were its needlessness, it might be allowed to cumber the statute books, with no charge against it more serious than meddlesomeness, albeit, to my thinking, that is not a slight charge. But this legislation is very far from being harmless. While it must be difficult for those unfamiliar with the methods and results of scientific inquiry and practical work in the directions touched by this bill to realize fully all of the ways in which the provisions of this complicated measure would hamper investigations of importance to mankind, enough can be made clear to any reasonable man to show that neither this bill nor anything like it should ever be enacted into law

Of the many faults of this bill there is none more serious in principle or likely to be more hurtful in the actual working of the proposed legislation than that this bill puts in the hands of men, who need not be and are not likely to be physicians or men of science, arbitrary powers, requiring skilled knowledge in their use, concerning matters of the highest importance to medicine and biological science and to the welfare of mankind. To the Commissioners of the District of Columbia, of whom two make a majority, is given uncontrolled power to determine by whom and where experiments

shall be made, to disallow or suspend at any time permission once granted, to demand at stated times reports in any desired form or detail concerning the methods and results of experiments, which reports shall be published, and to be, in the last resort, the supreme judges as to whether a certain experiment will advance physiological knowledge or knowledge "useful for saving or prolonging life or alleviating suffering," or will aid in the acquirement of "surgical experience." No provision is made for an appeal or a hearing on the part of any applicant or experimenter who may consider himself aggrieved. Of the partial exemption of officers of the government and of division of authority with the President of the United States I shall speak later.

Nobody can foretell in what manner the commissioners will exercise these extraordinary powers if conferred on them. It lies entirely in their discretion to grant all licenses and certificates or to refuse all and thereby prohibit all animal experimentation in the District, except that conducted under severe restriction by officers of the government. It can be confidently predicted that the antivivisectionists will use every political and other influence in their power to secure the appointment of commissioners committed to a policy hostile to animal experimentation. Physicians have other matters to attend to and rarely engage in political agitation. I know of no reason why either of the two eminent lawyers who have spoken today for our opponents should not be considered qualified for the office of Commissioner of the District of Columbia, but, entertaining the opinions on vivisection which they have expressed, how could they conscientiously grant a single license to experiment on animals? In whatever way the commissioners might exercise their uncontrolled discretion, whether they made the law mean much or little, one thing is certain: In matters requiring expert knowledge and of high importance to mankind, those who do not know would be put in supreme authority over those who know. This is a monstrously false and dangerous principle to embody in law. It needs knowledge, often a great deal of it, to do good, but none to hinder it.

It has been said that there is no more reason to object to the requirement of a license to experiment on animals than to that of a license to practise medicine. There are differences between the two cases, which I shall not pause to discuss, for this bill is not a simple licensing measure. To make the conditions of the two cases analogous, in accordance with the provisions of this bill, the law to license practitioners of medicine should provide that a body of laymen should determine the qualifications of applicants and grant the license to practise, that the practice of each licensee must be limited to certain specified localities, that the permitted manner of treatment should be prescribed with some detail, that certain therapeutic procedures should

be prohibited, that each practitioner must report at stated times his methods and results, and the number of patients treated to the licensing body, which shall publish the reports, and that body of inspectors with no statement as to their qualifications should keep the licensed practitioners under surveillance and should report from time to time the result of their observations. Manifestly absurd as such requirements as these would be if applied to the regulation of medical practice, they are scarcely less absurd when applied as proposed in this bill, to the legal regulation of animal experimentation.

If I were to enter into criticism of the smaller details of this complicated bill I would inquire, among other things, why only certain professors in medical schools are accorded the privilege of signing an application for a license, why, for example, the professors of pathology and of physiological chemistry are excluded, but it seems to me more important for my present argument to take up the larger defects of the measure.

The bill "for the further prevention of cruelty to animals in the District of Columbia," originally introduced in the Fifty-fourth Congress, placed the officers of the United States Government completely under the control of the Commissioners of the District in respect to animal experimentation, although the experimental work of the United States Bureau of Animal Industry concerns itself with the agricultural and stock-raising interests of the entire country. The subjection of government officers to the authority of the District Commissioners in a matter of this kind is so manifestly improper that the bill, after several modifications, now exempts from the necessity of securing a license from the commissioners any "medical or scientific officer of the United States Government duly authorized by the head of a department." But the bill still provides that those officers of the government who engage in animal experimentation must report to the District Commissioners twice a year on the "methods employed, the number and species of animals used, and the results of their experiments, in such form and with such further details as the said commissioners may require," and all these reports must be published. It is not the head of a department who is to make these reports, but such of his subordinates as may be engaged in experimental work. All of the other restrictions of the bill, some of which will require interpretation by the administrators of the law, also apply to the experimental work of the officers of the general government, which work is therefore still placed to a considerable degree under the control of officials of the District of Columbia.

The present bill, in its recently amended form, requires "that every place for the performance of experiments on living animals shall first be approved by the Commissioners of the District and shall be registered in such manner as the said Commissioners may direct." In the previous bill the provision

as regards registration of places was mandatory only for places of medical instruction. It will be noted that this provision applies to experiments on any living animal, invertebrate as well as vertebrate. This bill is the first which has ever taken under its protection mollusks, worms, insects and other invertebrates. This is really so absurd that it may be presumed to be the result of inadvertence, but, if so, it illustrates the lack of care in the construction of the bill.

The requirement that no experiment shall under any circumstances be made except in a place previously approved and registered is a very injurious one. A number of instances might be cited of the ways in which this requirement may interfere with useful experimentations and even involve some danger to human beings and animals. An emergency may readily arise in which some inoculation test for diagnostic or other purposes can most advantageously be performed where the material obtained directly at autopsy or from a patient or sick animal is directly at hand. In some instances absolutely fresh material, possibly inoculation directly from one animal to another, or from a human being to an animal, is essential for the success of an experiment. There may be considerable danger involved in the transportation of some highly virulent material, perhaps for a considerable distance, to a registered place, and there may be good reason for not taking infectious material away from a locality already infected and introducing it into an uninfected registered place. To confine the work of an experimenter absolutely and under all circumstances to the particular place for which he has secured a ticket of registration is a hard and unnecessary restriction, and in introducing this provision the new bill has gone beyond its predecessors and beyond the British law.

Undoubtedly the provision of this bill, as of all antivivisection bills, which is dearest to the heart of the antivivisectionist, is that for the official inspection of experiments on animals. The bill provides (Section 6): "That the President of the United States shall cause all places where experiments on living warm-blooded animals are carried on in the District of Columbia to be from time to time, visited and inspected without previous notice for the purpose of securing compliance with the provisions of this Act; and to that end shall appoint four inspectors, who shall serve without compensation and who shall have authority to visit and inspect the places aforesaid, and who shall report to the President of the United States from time to time the results of their observations therein, which shall be made public by him."

It will be observed that this section introduces a second authority in the administration of this law. The Commissioners of the District grant the licenses of persons and places, while the President of the United States appoints the inspectors and receives their official reports. This division of

authority would not seem conducive to the smooth working of the law and might readily lead to serious conflicts in its two-headed administration, especially if one head be friendly and the other hostile to experimental investigations.

But the monstrous evil of the provision regarding inspectors is that not a word is said as to the need of any special qualifications on the part of those who are to scrutinize and report on the experimental work of physicians and scientific men. The duties of these inspectors, according to the law, will require them to base their reports on such matters as whether animals are completely anaesthetized, whether movements of an animal are manifestations of conscious pain or only of reflex action whether experiments are conducted by competent persons and in a proper manner, and whether they are useful for the particular purposes specified in this bill, and fall under the categories of permitted experiments. Surely some knowledge of physiology and some appreciation of the needs of medicine and surgery are required for the performance of the remarkable and responsible functions of these inspectors.

The bill originally introduced provided that this inspection should be by an agent of the Washington Humane Society, a notoriously antivivisectionist's society, which claims the responsibility for this bill. It cannot be doubted that this society and antivivisectionists in general will claim and in all probability will secure representation among the inspectors. It would be quite within the power of even one energetic and officious inspector, without physiological knowledge and opposed, as most antivivisectionists are, to all investigations requiring experimentation on animals, to make the conditions of experimental work simply intolerable. Anybody who has serious and legitimate business to attend to has a right to object to constant intrusion and disturbance, and work requiring delicate manipulations and undivided attention cannot go on under such interruptions. When to this nuisance is to be added the publication of official statements concerning difficult matters of which the observer is not qualified to judge, I submit that before you impose on experimenters this system of inspection you should be convinced that very great abuses are to be corrected and can be corrected by no procedure of a less drastic nature.

It is utterly misleading to draw any analogy between this sort of inspection of banks and insurance companies, and it is a libel on common sense to assert, as is done by advocates of this measure, that fear of the exposure of wanton cruelties moves experimenters to object to any such system of inspection as that proposed in this bill. It is not true that secrecy surrounds the practice of animal experimentation. Reports of experiments are published in detail. Any qualified person has free access to the laboratories

where such experiments are made, but to throw them wide open to the public is open to the same kind of objections as would be similar publicity for surgical operations. The antivivisectionists are fond of quoting from an address by Dr. Parvin, delivered in 1891, but I have never known them to cite in their writings, except in garbled form, the following sentences from this address: "Should the law restrict the performance of vivisection? I think it ought, chiefly as an expression of public sentiment and for the moral effect, for violations of its provisions could usually only be discovered by a system of espionage, by the employment of detectives, of spies and informers, utterly alien to our system of government, and who are as a rule abominable." This quotation in antivivisectionist's publications always, I believe, stops short with the first third of the last sentence.

Who are to be subjected to the visits and inspection of these officials? It can be confidently asserted that the inspection will be practically limited to laboratories under the supervision of scientific men of established reputation, who have been selected by universities, medical colleges and heads of governmental departments for their recognized skill and knowledge. Dr. Bowditch has told you that he knows of no private vivisections by students, and I can say the same. Vivisection by physicians in their homes is very uncommon. The men who, as your chairman said on a previous occasion, do not need legal enactments are precisely the ones who are to be subjected to the annoyances of this system of inspection and in general to the vexatious restrictions of this bill, while, if the class of persons for whom this bill is said to have been framed really exist and now keep effectually concealed without any apparent motive, I do not see how this law is likely to reach them after their detection will lead to the infliction of a severe penalty.

Not only are the inspectors to make reports of the results of their observations which shall be published by the President of the United States, but "the Commissioners of the District shall direct every person performing experiments under this Act to make reports to them on the first day of January and July of each year, of the methods employed, the number and species of animals used, and the results of their experiments, in such form and with such further details as the said Commissioners may require: Provided only, that reports of any series of experiments alleged to be incomplete may be postponed by permission of said Commissioners for a period not exceeding six months. All such reports shall be published." (Sec. 5.)

Inasmuch as the new bill begins, after the enacting clause, with these words: "That hereafter no person shall perform on a living animal any experiment calculated to give pain to such animal, except subject to the restrictions hereinafter prescribed," it would appear that this latter provision regarding reports of experiments and their publication applies to

experiments on invertebrates as well as vertebrates, for I know of no reason to suppose that an invertebrate may not suffer pain.

The period of six months allowed for the completion of experimental researches before the necessity of furnishing for publication reports thereon in whatever form and detail the commissioners require is so short that an experimenter will often be subjected to the hardship of either closing an investigation without satisfactorily completing it or of submitting to the outrage of having methods and results of half finished investigations spread before the public. It must be difficult for those unfamiliar with the conditions of scientific inquiry to fully appreciate these hardships. This requirement cannot fail to injure the quality of scientific work and there are many useful investigations which would probably not be undertaken at all under such vexatious conditions. It is to be noted that in the previous bill the demand for reports on experiments was left to the discretion of the commissioners, whereas now these reports must be sent in at stated times and not in such form and with such details as the experimenter may wish, but in any form and with any details which the commissioners may require. Here, as with so many other provisions of this bill, the law can be so administered as to harass experimenters almost beyond endurance.

Those unacquainted with the real purposes and the methods of antivivisectionists would probably not anticipate one of the uses to which can be put the official records of licenses and certificates and the reports of experiments, but it is interesting to note that Sir John Simon, the most eminent of English sanitarians, formerly medical officer of Her Majesty's Privy Council, in his testimony in 1875, before the Royal Commission on Vivisection, clearly predicted this use or rather abuse. In replying to questions as to his opinion of a law embodying this system of licenses, inspection and official returns of experiments, he said (Report of the Royal Commission, etc., p. 77, London, 1876): "I think it would not be a security for animals, and I think it would give facilities for the persecution of physiologists. I think that physiologists under law of this sort would in these days run some risk of being treated as Vesalius was three centuries ago. . . . . I should be very unwilling, I confess, to see physiologists put in a position in which those who are now making clamor on these subjects should be able to hold them up individually to popular odium; and under this clause" (*i. e.*, that relating to official returns of experiments) "that could be done." I have here the second edition of a book entitled "The British Vivisector's Directory; A Black Book for the United Kingdom," by Benjamin Bryan; with a Preface by Frances Power Cobbe, London, 1890. One sentence from Miss Cobbe's preface will serve to indicate that a main purpose of this book is to black-list experimenters. In speaking of experimenters on

animals she says: "Could the older non scientific men and the tender-hearted women with whom they associate behold for one moment in some magic mirror, their employment of a few hours before over their torture troughs, they would be shunned and abhorred as unfit to belong to civilized society." The book is accompanied with comments full of misrepresentations and sometimes with gross misstatements of facts.[1] It is for you to consider whether you will place in the hands of antivivisectionists the opportunity to issue such appeals as this to elderly non scientific men and tender-hearted women to ostracize a list of physiologists, whose names and experiments appear, accompanied by false and misleading statements, in a printed catalogue. It matters not that the list of names is in fact a roll of honor.

I desire to call attention, with especial emphasis, to a question about which more diversity of opinion has been expressed than concerning any other aspect of this bill. Will this bill, if it becomes law, prohibit important and useful experiments? Its advocates are vehement in their assertion that it is simply "restrictive and not prohibitive" and "concedes everything of utility," and they charge its opponents, who claim that the bill prohibits useful experiments, with misrepresentation or with ignorance of its provisions. The bill has been printed repeatedly in medical journals of this country, and has been fully discussed there. The accusation is unwarranted that protests against its enactment, which have been sent in hundreds to senators and representatives in Congress, by medical and scientific men and societies, are based on ignorance of the contents of the bill. There can

[1] An illustration of the way in which antivivisectionists misrepresent facts is furnished by a book entitled The Nine Circles, which has the name of Miss Cobbe on its title-page, and for which she wrote the preface. At the Church Congress at Folkstone, October, 1892, Mr. Horsely called attention to this book in the following words: "In the book, all the experiments are grouped by Miss Cobbe as English and Foreign, respectively. I have taken the trouble to collect, from this gospel of Bishop Barry and Canon Wilberforce, all the experiments in which cutting operations are described as having been performed by English scientists, and in which I knew anaesthetics to have been employed. These experiments are twenty-six in number. In all of them, chloroform, ether, or other anaesthetic agent, was employed. But of these twenty-six cases, Miss Cobbe does not mention this fact at all in twenty, and only states it without qualification in two out of the remaining six. When we inquire into the twenty omissions in the twenty-six cases, we find in the original that again and again Miss Cobbe has, in making her extracts, had directly under her eyes the words 'chloroform,' 'ether,' 'etherized,' 'chloroformed,' 'anaesthetized,' 'during every experiment the animal has been deeply under an anaesthetic,' and so forth." (*The Standard*, London, Oct. 7, 1892). Miss Cobbe subsequently explained that the book was "planned and compiled by her direction," but the actual work of compilation was done by another.

be no doubt as to which side is the more competent to give a correct response to this question, the great body of medical and scientific men who answer it affirmatively, or those practically unfamiliar with animal experimentation and with physiology and medicine, who represent the negative.

I have already pointed out that this bill leaves it entirely to the discretion of two laymen, who constitute the majority of the District Commissioners, and who cannot be shown to possess any special qualifications to judge of the matter, to determine whether any experiments on warm-blooded animals shall be performed in the District of Columbia. I need not recur here to the partial exemption of officers of the government from the control of the District Commissioners. I have also shown how the numerous restrictions, such as the quadruply endorsed applications, the licenses, the registrations of places, the inspections, the requirement at stated periods of reports of methods, number and species of animals used, and results, the specifications as to purposes and conduct of experiments, place it entirely within the power of the administrators of the law seriously to hamper, and indeed actually to prevent, experimental investigations while nominally permitting them.

But aside from these prohibitive effects dependent on the manner of enforcement of the law, this bill in unmistakable terms expressly prohibits many important and useful experiments. The carelessness of construction and the vagueness, whether accidental or intentional, of certain provisions of the bill leave it uncertain whether some other useful experiments are forbidden or not.

The only experiments on warm-blooded animals permitted by this act are those for "the advancement of physiological knowledge or of knowledge which will be useful for saving or prolonging life or alleviating suffering" or for "the acquirement of surgical experience likely to be of use in operations upon human beings" (Section 2, *a*), in which experiments "the animal must, during the whole of the experiment, be completely under the influence of ether or chloroform (or any other recognized anaesthetic)," (Section 2, *c*). There are six, and only six, exceptions to these requirements, to-wit: 1. "Experiments may be performed under the foregoing provisions as to the use of anaesthetics by a person giving illustrations of lectures in medical schools or colleges, on a certificate being given, such as is required for a license as hereinafter provided in section seven, to the effect that the proposed experiments are absolutely necessary for the due instruction of the persons to whom such lectures are given, with a view to their acquiring knowledge or experience which will be useful to them for saving or prolonging life or alleviating suffering"; 2, "in so-called inoculation experiments or 3, tests of drugs or medicines, or 4, foods, or 5, in experiments relating to the communicability of disease, the animal need not be

anaesthetized nor killed afterwards, nor 6, in tests of surgical procedure need animals be kept completely anaesthetized during the process of recovery from the surgical operation." (Section 2, *c.*)

I cannot claim familiarity with all of the antivivisection bills which have been introduced into legislative bodies. I know that many are very curious productions, but I should be surprised to learn that there are any, stopping short of total prohibition, which have been more prohibitive in their provisions than this so-called "moderate and reasonable" bill before us. Who was it that, in copying the phrases of this bill from the British act, struck out bodily the three provisions in the latter, absolutely essential for the continuance of experimental work in its legitimate scope, granting permission, when the necessities of the investigations demanded: 1, for the performance of experiments without anaesthetics; 2, for the survival of the animal after the operative part of the experiment, and 3, for the performance of experiments "for the purpose of testing a particular former discovery alleged to have been made?" Was it some one who tells us that this bill "goes to the farthest extreme of concession in the anxiety of its framers to yield to the wishes of scientific men so far as may be consistent with the principle of legal supervision?" Does anybody suppose that the exceptions concerning inoculation experiments, tests of drugs, medicines, or foods, experiments relating to the communicabilty of disease, and tests of surgical procedure can begin to take the place of all the experiments forbidden by the omission of the provisions mentioned? Misapprehension there may have been as to the effects of this bill, but it has not been on the sides of those who have emphasized its prohibitive features.

I could spend the entire time allotted to me in enumerating useful experiments absolutely prohibited by this bill, but it must suffice to call attention to a few of the more important classes of prohibited experiments.

No scientific man who reads this bill and notes the definitions of the purposes for which experiments are permitted and the enumeration of the few kinds of experiments excepted from certain prohibitions can fail to be impressed with the fact that the whole emphasis is laid on immediate practical utility. The framers of the bill had evidently no broader conception of science than that short-sighted Philistine one which sees no value in scientific discoveries unless they be of immediate practical application. They seem not to know that the foundations of applied science rest on discoveries in pure science made without thought of direct practical utility. Experiments made solely with a view of advancing physiological and pathological knowledge without immediate reference to their practical applications are precisely the ones which have yielded the richest harvest of results applicable to the diagnosis and treatment of disease. Such was the history of

the discoveries of antitoxin, of the principles of antiseptic surgery, of the treatment of myxoedema and cretinism by the thyroid extracts, and of many other therapeutic and diagnostic procedures based on the results of animal experimentation.

Instead of some simple and comprehensive definition of the purposes for which experiments can be made, such as "for advancement of medical and biological knowledge and promotion of the healing art," we find the clumsy, unsatisfactory and vague phraseology already cited from Section 2, *a*. The only instance in the entire bill of the recognition of any other immediate purpose of experimentation than one relating to the treatment of disease is the permission granted in this paragraph to perform experiments "with a view to the advancement of physiological knowledge." The latest bill has even removed the word "physiological," found in all the previous bills, for the designation of one of the kinds of knowledge for the acquirement of which by students demonstrative experiments may be made in illustration of lectures. It is not customary to designate by the epithet "physiological" the kind of knowledge sought for in pathological and bacteriological experiments, and nevertheless, by no means all of these experiments are made for the purpose of acquiring knowledge directly "useful for saving or prolonging life or alleviating suffering." There is a science of pathology as well as of physiology. Together they make the foundation of scientific medicine. Each is most surely advanced by its cultivation for its own sake. The ultimate purpose of obtaining knowledge useful to practising physicians and surgeons is far more likely to be secured by the experimental work of those experts who devote themselves to physiology and pathology as sciences than by experiments made with direct reference to their application to the treatment of disease. It is difficult to say whether the term "physiological" will be interpreted by the administrators of the proposed law in some broad unusual sense so as to include all pathological, bacteriological, hygienic and chemical experiments not performed for the immediate purpose of advancing knowledge "useful for saving or prolonging life or alleviating suffering." Certainly no such vagueness and doubt as to the interpretation of the law should have been permitted as regards these important classes of experiments.

The bill provides that the animal must be completely anaesthetized during the whole of the experiments and, if the pain is likely to continue or any serious injury has been inflicted must be killed before recovery from the influence of the anaesthetic. (Section 2, *c*.) The previous bills contained the ridiculous requirement that only ether and chloroform could be used as anaesthetics, whereas in the last bill permission is parenthetically granted to use "any other recognized anaesthetic." Those acquainted with antivivisectionist's writings must have observed the absurd notions contained therein

regarding the distinction between anaesthetics and narcotics, so far as the production of insensibility to pain is concerned. It is there stated that such narcotics as morphia and chloral, which on account of their prolonged narcotic effects are often useful and most merciful in animal experiments, do not even in large doses render animals insensible to pain. The so-called narcotics are administered to animals in doses relatively much larger than for human beings and in ways securing prompter effects, but to the antivivisectionist none of these is a "recognized anaesthetic." I apprehend that the present phraseology of this bill is calculated to leave it to the decision of the Commissioners of the District of Columbia whether the use of certain narcotic substances, although in fact capable of producing insensibility to pain, shall be permitted in animal experimentation. Doubtless the judgment of this tribunal on this question will be eagerly awaited by the medical world. Anaesthetics and narcotics differ among themselves in their effects on the circulation, respiration and other functions, and, while ether and chloroform are the most generally useful, the exigencies of a research may require the employment now of one and now of another without introducing any difference in the completeness of the insensibility to pain.

The use of curare as an anaesthetic is forbidden by this bill. Curare is not in fact used as an anaesthetic by the physiologists, but it hardly seems necessary for Congress to pronounce on the question of its anaesthetic properties. Bernard, who believed that curare does not produce insensibility to pain and whose theatrical description on this subject is extensively quoted in antivivisectionist's literature, correctly stated, in the following words, the only way in which this question can be decided: "Man alone, after recovering from poisoning by curare, could tell, supposing that he preserved his memory, whether or not he had suffered." Since Bernard's experiments, over forty years ago, other experiments have been made, some of which show that curare in the doses used in the laboratory acts on the sensory as well as the motor nerves, and, what is most pertinent to the question, there have been instances reported of the accidental poisoning of men by curare, who recovered and in whom sensation was totally abolished, while the action of the drug was apparent. (Stephen Paget: Experiments on Animals, pp. 243-245. London, 1900.)

There are painful experiments, fortunately very exceptional ones, in which the objects of the experiment would be frustrated by the use of an anaesthetic. Such experiments are permitted under certificates by the British law, but are prohibited by this bill—excepting inoculation experiments, tests of drugs, medicines or foods, and experiments relating to the communicability of disease. When one considers that the discovery of the separate functions of the spinal nerve roots, probably the most fundamental discovery

in physiology next to that of the circulation of the blood, is based on experiments under this category, the possible injury to science which may result from the absolute prohibition of this class of experiments is sufficiently apparent.

Perhaps the largest and most important class of useful experiments prohibited by this bill comprises those in which the purposes of the investigation require the survival of the animal for periods of time too long for the practicable continuance of the anaesthesia. Nothing in this bill is more curious or more characteristic of the ignorance of its framers in scientific and medical matters than the little list of cases in which it is permitted to dispense with an anaesthetic or to allow the animal to recover from the influence of the anaesthetic before killing it. To the three exceptions which permit the survival of the animal, enumerated in previous bills, the present bill has added "tests of foods" and "experiments relating to the communicability of disease." The expression, "tests of drugs, medicines or foods," is certainly a very peculiar and, at least to members of the regular profession, unfamiliar designation of investigations in pharmacology and nutrition. It is hard to see why "tests" of other therapeutic procedures than those of drugs, medicines and foods should be excluded from this list, but I suppose that we ought to be grateful for this new concession that animals need not be anaesthetized or immediately killed while feeding them during these "tests of foods."

It is difficult to see what of importance is added to this meager list by the insertion, in the new bill, of "experiments relating to the communicability of disease." A communicable disease is of course a contagious disease, and there do not occur to me any important experiments relating to its communicability which do not come under the already permitted class of "inoculation experiments." But if experiments permitting the survival of the animal may be made with reference to the "communicability of disease" why in the name of common sense may they not be made with reference to the study of the causation, the diagnosis, the prognosis, the pathology of disease?

It will be noticed that this singular little group of experiments which constitutes the only ones in which the animal is permitted to survive the influence of the anaesthetic are all experiments supposed to be of immediate practical utility although they represent only a very small fraction of such experiments, most of which have just as much claim to be included as those which actually appear in the list. I have already indicated the fundamental error of conception, nowhere, in this remarkable bill, more strikingly manifested than here, which attributes supreme importance to experiments conducted with a view to their immediate, practical application to the treatment of disease.

With the five exceptions—inoculation experiments, tests of drugs or medicines, tests of foods, tests of surgical procedure, experiments relating to the communicability of disease—all physiological and pathological experiments in which the ends of the experiment can be attained only by observation of the animal for days or weeks are prohibited by this bill. Such important experiments as those which have shed light on the processes of digestion by gastric, biliary, pancreatic or intestinal fistula, on the functions and sounds of the heart by experimental production of valvular lesions, on the functions of the brain and spinal cord, of the kidneys, of the thyroid gland, of the liver and, indeed, of most of the organs of the body by observations extending over some length of time after an experiment, are all prohibited by the conditions of experimentation imposed by this bill. The list of prohibited experiments of this class is so long that I cannot attempt to enumerate them. It has been asked whether the experiments on the brain and on the liver, cited by Dr. Keen as the basis for his successful operations, could not be performed under the provisions of this bill. They could not, for they required the survival of the animal after an operation inflicting serious injury, and they were not undertaken as tests of a surgical procedure or with reference to the communicability of disease, but for purely physiological and pathological purposes. Nor does the bill permit such experiments as those cited by Dr. Hare, which have led to the successful treatment of myxoedema and forms of cretinism. If this bill included no more than the provision forbidding the performance of this class of experiments its enactment would inflict a blow, simply brutal, on biological and medical science. It is conceivable that the framers of the bill did not know what they were doing when they inserted this prohibitive feature, but that surely does not put the matter in any better light.

It does not seem to me necessary, nor in the limited time is it practicable, to continue with an enumeration of all the useful classes of experiments prohibited by this bill. To some others I have called attention in Senate Document No. 104, 55th Congress, Second Session, but no one has ever attempted anything approaching a complete list of the prohibited experiments. I may here say that it is not clear to me what is meant by the assertion repeatedly made by advocates of the bill, that inoculation experiments are excluded from its operation. They are subject just as much as any other experiments to all its restrictions except that the animal need not be anaesthetized during the operation or killed afterward. The magnitude of the concession that an animal—a mouse is the one oftenest used—need not be anaesthetized for the prick of a needle or kept unconscious for days or weeks seems to have made an extraordinary impression on the supporters of this bill. Enough has been said to demonstrate that this bill explicitly prohibits many experiments of the highest scientific and practical value, including

many which involve less suffering to the animal than some that are permitted. These unambiguous prohibitive features of the bill have been pointed out again and again in published documents but I have never seen any answer vouchsafed to these apparently weighty criticisms, nor do I expect to hear any today.

One of the speakers on the other side devoted a large part of his remarks to the subject of vivisection in public schools. The only reply which seems necessary is that the existing law permits only "properly conducted scientific experiments or investigations which experiments shall be performed only under the authority of the faculty of some regularly incorporated medical college, university or scientific society," and that the Superintendent of Public Schools, on April 24, 1896, wrote, "Vivisection has never been practised in the schools of the District of Columbia, so far as I have been able to ascertain after the most diligent inquiry. No legislation is necessary on this subject, because the authorities of the schools are radically opposed to vivisection except by experts for scientific purposes, and will do every thing in their power, without legislation, to prevent its occurrence in the public schools."

One of the most irrational features of the previous bills has apparently been eliminated from the new or substitute bill printed on March 9, 1900, through the substitution of the words "warm-blooded" for "vertebrate," but there seems to have been some carelessness in carrying out this correction. In Section 7 and 8 the license under the act is spoken of as one "for the performance of experiments on living animals," and I have already mentioned that Section 3 requires that "every place for the performance of experiments upon living animals" shall be approved and registered. There is also apparently some uncertainty on this point in Section 5. It is charitable to suppose that these slips and uncertainties are not intentional, but if due care had been exercised they would not have appeared.

In looking over the British law on this subject I was impressed by the following provision which would seem to afford experimenters considerable protection against persecution: "A prosecution under this Act against a licensed person shall not be instituted except with the assent in writing of the Secretary of State" (the authority administering this law). I am not a lawyer and cannot say whether the omission of a similar safeguard from the present bill is based on legal grounds, but if not, then I do not care to comment on the motives of those who copied so much of the British law and left out this valuable protection to physiologists against unjust and malicious prosecutions.

Although I have not by any means exhausted the objections to this legislation, and have left untouched a number of just criticisms on it, already

presented in various public documents, I see no necessity of occupying more time in a discussion of other objectionable provisions, after the hopelessly defective character of the bill has once been made sufficiently clear. I trust that it has been demonstrated to the satisfaction of the members of this committee that no further legislation on this subject is necessary; that this law, in attempting to restrain abuses, of whose existence there is no evidence, would do far more harm than by any possibility good, by seriously hampering the work of scientific investigators; that many of the leading provisions of the bill are monstrously wrong in principle and would be most detrimental in practice to the interests of medicine and biological science; that the proposed law is capable of being administered so as to prevent all animal experimentation, and does in fact explicitly prohibit a large number of important and useful experiments.

Before closing I should like to advert to two points which are pertinent to the discussion of this sort of legislation, viz.: its inequality and the experience with similar legislation in Great Britain.

The fact that legislation is class legislation is, I know, not decisive as to its propriety, but it does raise a prejudice, often a justifiable one, against it. Sir John Simon, in his testimony before the Royal Commission on Vivisection, forcibly presented the unequal character of such legislation as that contemplated in this bill. He said:

"You must take this question of physiology with the general social context; and I do this as impartially as I can when I think of projects of legislation in the present matter. I take up, for instance, one of these Bills, and I find this: 'Whereas, it is expedient to prevent cruelty and abuse in the *experiments made on living animals for the purpose of promoting discoveries in the sciences of medicine, surgery, and physiology.'* . . . . Do you suppose that one of Magendie's experiments, the worst of them, is more cruel to the sufferer of it than hare hunting to the individual hare, or fox hunting to the individual fox? And is animal life less to be protected against 'cruelty' when the life is sacrificed for purposes of science? You are proposing that physiologists shall be treated as a dangerous class, that they shall be licensed and regulated like publicans and prostitutes; what I would venture to put before you is, that this would be fancy legislation, touching the relations of man to the lower animals at a little bit, and a comparatively unimportant little bit, of the subject matter; and that society would come to such legislation with unclean hands. Who is the accuser of the physiologist? Society assumes universal right to slaughter animals for its food, to cut their throats and wring their necks at its discretion, and neither stints its luxury (much less its hunger) in reluctance to take life, nor troubles itself much about painless methods of killing. To kill particular animals in particular ways is a considerable branch of national amusement, and the wealthy breed certain animals on a large scale exclusively to have sport in killing them, and for the unpracticed often to mangle where they do not kill. Also with a view to slaughter, or with a view to other service, society inflicts

sexual mutilation on nearly all the males of the cattle, horses, sheep and swine, which it controls, and, as to swine, on many of the females. You never eat a mutton chop that does not come from an emasculated sheep; you rarely use a male horse that has not had its testicles cut out. Now, when the common habit of society treats domestic animals in this way, slaughtering and mutilating them at will for use, for convenience, for luxury, and while battues and wager-slaughtering and hare-hunting are elements of national sport, it seems altogether monstrous to put into a separate category the extremely small use which physiology (for great human interests) makes of the lives of brute animals, and to have as the preamble of a bill that cruelty is to be prevented in that one relation while all other relations are to be left loose."

We have no opportunity to judge from actual experience of the practical results of vivisection legislation so restrictive and so unintelligent as that in this bill. The experience, however, for the last quarter century in Great Britain, the only country which has hitherto introduced legislation of this character, should be quite sufficient to warn law-makers elsewhere against the adoption of all such legislative proposals and it is the strongest incentive to scientific and medical men in other countries to resist to the utmost the imposition of similar shackles upon freedom of scientific investigation. The bill before us was copied in its main features from the British law, although, as I have pointed out, with restrictive additions and with the omission of important concessions and safeguards. The British law, although, unlike this bill, not prohibitive of any important kinds of experiment, surrounds the practice of animal experimentation with severe and harsh restrictions and has been rigorously enforced. That it has not crushed the life out of British physiology and experimental medicine is evidence of their inherent vitality and of the indomitable energy of scientific workers in that land. Of its harmful effects I shall bring testimony presently.

The law was enacted by Parliament in 1876, avowedly to satisfy public clamor, and at a period just before the beginning of modern bacteriology, which has furnished such irrefragible proofs of the benefits of animal experimentation to practical medicine Lord Sherbrooke—then the Right Hon. Robert Lowe—has correctly characterized, in the following words, the report of the Royal Commission which was appointed to inquire into the existence of abuses of vivisection:

"The Commission has entirely acquitted English physiologists of the charge of cruelty. They pronounced a well-merited eulogium on the humanity of the medical profession in England. They pointed out that medical students were extremely sensitive to the infliction of pain upon animals, and that the feeling of the public at large was penetrated by the same sentiment. They then proceeded to consider to what restrictions they should subject the humane and excellent persons in whose favor they had so decidedly reported. Their proceeding was very singular. They acquitted the accused, and sentenced them to be under the surveillance of the police for life. ('Contemporary Review,' October, 1876.)"

Unfortunately physicians and scientists in England at the time made no such determined opposition against the proposed legislation as their colleagues are doing in this country in the case of the present bill. Many of them believed that acquiescence would put a stop to the mischievous agitation of antivivisectionists who, as the Royal Commission showed, had misled a considerable section of the public to credit their *ex parte* statements concerning the existence of serious abuses. In this belief our English brethren were grievously mistaken, and they have earnestly warned us not to fall into their error. This legislation has in no measure accomplished its avowed purpose to afford an antidote to unjust suspicions, nor is this failure due to any lack of rigor in the enforcement of the law. As Stephen Paget says:

"The working of the act is subjected to ceaseless espionage both inside and outside Parliament. Candidates at elections are heckled over it; bullying letters are written to Her Majesty's Ministers; scientific journals are ransacked to find evidence for "The Cause"; black-lists of men to be boycotted are published; and people are asked to give nothing to the big hospitals with schools, and everything to one or two little hospitals without schools.

As Dr. Bowditch has told you and as all familiar with their ultimate aims know, the antivivisectionists, in deference to whose wishes the British law was enacted, are not in the least satisfied with its operations and are clamoring for total prohibition. You will have no better success if you defer to their immediate desires as regards this bill, while you may be assured that its passage will encounter the hostility of the entire medical profession of this country and will inflict grievous injury on medical science and art. The truth is that this legislation is directed against a phantom, and the phantom will not be exercised by any measure which stops short of the total prohibition of all animal experimentation, perhaps not even then.

Out of a considerable number of letters on this subject from English physicians, all to the same general purport, I have selected four on account of their weight of authority, which should convince you of the injury to scientific and practical medicine inflicted by the British law. The first letter which I shall present is from Lord Lister, president of the Royal Society, whose name is immortal in the annals of medicine, one of the greatest benefactors of mankind through his discovery and introduction of the principles of antiseptic surgery. It was written in 1898 and addressed to Dr. W. W. Keen.

Letter of Lord Lister

"*My Dear Sir.*—I am grieved to learn that there should be even a remote chance of the legislature of any state in the Union passing a bill for regulating experiments on animals.

It is only comparatively recently in the world's history that the gross darkness of empiricism has given place to more and more scientific practice;

and this result has been mainly due to experiments on living animals. It was to these that Harvey was in large measure indebted for the fundamental discovery of the circulation of the blood, and the great American triumph of general anaesthesia was greatly promoted by them. Advancing knowledge has shown more and more that the bodies of the lower animals are essentially similar to our own in their intimate structure and functions: so that lessons learned from them may be applied to human pathology and treatment. If we refuse to avail ourselves of this means of acquiring increased acquaintance with the working of that marvelously complex machine, the animal body, we must either be content to remain at an absolute standstill or return to the fearful haphazard ways of testing new remedies upon human patients in the first instance which prevailed in the dark ages.

"Never was there a time when the advantages that may accrue to man from investigations on the lower animals were more conspicuous than now. The enormous advances that have been made in our knowledge of the nature and treatment of disease of late years have been essentially due to work of this kind.

"The importance of such investigations was fully recognized by the commissioners on whose report the Act of Parliament regulating experiments on animals in this country was passed, their object in recommending legislation being professedly only to prevent possible abuse. In reality, as one of the commissioners, the late Mr. Erichsen, informed me, no single instance of such abuse having occurred in the British Islands had been brought before them at the time when I gave my evidence, and that was toward the close of their sittings. Yet in obedience to a popular outcry, the government of the day passed an act which went much further than the recommendations of the commissioners. They had advised that the operation of the law should be restricted to experiments upon warm-blooded animals; but when the bill was considered in the House of Commons a member who was greatly respected as a politician but entirely ignorant of the subject-matter suggested that 'vertebrated' should be substituted for 'warm-blooded'; and this amendment was accepted by a majority as ignorant as himself.

"The result is that, incredible as it may seem, anyone would now be liable to criminal prosecution in this country who should observe the circulation of the blood in a frog's foot under the microscope without having obtained a license for the experiment and unless he performed it in a specially licensed place.

"It can be readily understood that such restrictions must seriously interfere with legitimate researches. Indeed, for the private practitioner they are almost prohibitive, and no one can tell how much valuable work is thus prevented.

"My own first investigations of any importance were a study of the process of inflammation in the transparent web of the frog's foot. The experiments were very numerous, and were performed at all hours of the day in my own house. I was then a young unknown practitioner; and if the present law had been in existence, it might have been difficult for me to obtain the requisite license; and even if I got them, it would have been impossible for me to have gone to a public laboratory to work. Yet without these early researches, which the existing law would have prevented, I could

not have found my way among the perplexing difficulties which beset me in developing the antiseptic system of treatment in surgery.

"In the course of my antiseptic work at a later period I frequently had recourse to experiments on animals. One of these occurs to me which yielded particularly valuable results, but which I certainly should not have done if the present law had been in force. It had reference to the behavior of a thread composed of animal tissue applied antiseptically for tying an arterial trunk. I had prepared a ligature of such material at a house where I was spending a few days at a distance from home; and it occurred to me to test it upon the carotid artery of a calf. Acting on the spur of the moment, I procured the needful animal at a neighboring market; a lay friend gave chloroform and another assisted at the operation. Four weeks later the calf was killed and its neck was sent to me. On my dissecting it the beautiful truth was revealed that the dead material of the thread, instead of being thrown off by suppuration, had been replaced, under the new aseptic conditions, by a firm ring of living fibrous tissue, the old dangers of such an operation being completely obviated.

"I have referred thus to my personal experience because I have been requested to do so; and these examples are perhaps sufficient to illustrate the impediments which the existing law places in the way of research by medical men engaged in practice, whose ideas, if developed, would often be the most fruitful in beneficent results.

"But even those who are specialists in physiology or pathology, and have ready access to research laboratories, find their work very seriously hampered by the necessity of applying for licenses for all investigations and the difficulty and delay often encountered in obtaining them.

"Our law on this subject should never have been passed and ought to be repealed. It serves no good purpose and interferes seriously with enquiries which are of paramount importance to mankind. Believe me,

"Sincerely yours,
"LISTER."

The second letter is from the late Sir Thomas Grainger Stewart, professor of medicine in the University of Edinburgh, physician to the Queen, formerly president of the Royal College of Physicians of Edinburgh, and of the British Medical Association. The name of no British physician is more widely known and honored both in his own country and in America than that of Grainger Stewart, whose death occurred within the present month. The following letter was written in 1898:

LETTER OF SIR THOMAS GRAINGER STEWART

"*My Dear Dr. Keen.*—I much regret to hear that you are threatened with the kind of legislation which has in this country proved so detrimental to all branches of physiological and pathological science, and consequently to the practical medicine and surgery.

"It may have been true as the antivivisectionists of this country asserted, that cruelty was inflicted upon the lower animals for purposes of experiment and demonstration, but I can certainly vouch for it that I never saw any-

thing of the kind and I have been closely connected with the work of some of our chief medical schools ever since my graduation, nearly forty years ago.

"But I do know of my own experience that the laws passed in the interests of antivivisection have proved a great hindrance to original research among us—not that experiment is forbidden, for competent men can as a rule get permission. But the restrictions, the delays, the formalities that have to be gone through are so irksome as to hinder many competent men from undertaking researches, and to make it almost impossible for such workers as are actively engaged in practice to attempt elucidating research on any special occasion that emerges.

"I earnestly trust that a country which loves freedom as your country does, and which has during my professional lifetime made such enormous strides in advance as your country has, will not follow ours in adopting unfair and trammelling restrictions and checking the great career which American medicine has of late years been pursuing. With much regard, I am

"Yours very truly,
"T. GRAINGER STEWART."

The next letter, also written in 1898, is from Dr. T. Lauder Brunton, physician to St. Bartholomew's Hospital, London, a physician of great eminence, and author of the most scientific and authoritative text-book on pharmacology and therapeutics in the English language.

LETTER OF DR. T. LAUDER BRUNTON

"*Dear Dr. Welch.*—I regret extremely to hear that there is a movement in America to stop the progress of medicine by prohibiting experimentation upon animals. Those who have set this agitation on foot are no doubt well-meaning, but in their anxiety to prevent pain to the lower animals they are entirely forgetful of the consequences to man. It is through experimentation on animals that medicine and surgery have made such enormous strides of recent years, so that we are able to prevent the spread of infective diseases, to lessen mortality in such diseases as diphtheria, to relieve pain and induce sleep in ways that were unthought of thirty years ago, and to perform surgical operations on the abdomen which are now so common because they are so free of risk, whereas formerly such operations entailed the almost certain death of the patient. The good-hearted, but sentimental and mischievous persons who oppose experiments upon animals forget that animals as well as men must die and that the natural end to which all these animals would come is probably much more painful than death at the hand of the physiologist. It is a want of conception of the importance of experimentation in increasing the power of the medical man to relieve pain and prevent death that causes sentimentalists to oppose it. As an illustration of this, I may mention that shortly after the antivivisection act was brought into force in England, Sir Joseph Fayrer and I were prevented from carrying on, at our own expense, experiments on the action of snake poison and the best way of preventing death from it. This was done because snakes were almost unknown in this country and death from their bite is almost unheard of. But at the very

moment that we were prevented from doing the experiments here, the Government of India, knowing the importance of the research, as twenty thousand people die yearly from the bite of poisonous snakes in India, appointed their own officials, paying them salaries and providing them with all facilities to carry on the research in India which the government at home was preventing Sir John Fayrer and me from doing at our own expense. The Indian government realized the danger of death from snake bite while the home government did not, and consequently the former forwarded the research in order to prevent the suffering and death of its subjects while the latter was prohibiting such a research. It was the ignorance of the home government which led it to do this; it was the knowledge of the Indian government which has led it to act as it did.

"In America, the ignorant and prejudiced will be sure to take up the antivivisection cry, while the wise and truly benevolent will oppose the bill. The passage of the antivivisection act in this country has interfered to an enormous extent with physiological work, and in order to do some of my investigations, the object of which was simply to find out what the action of certain medicines was that one might apply them to the relief of suffering mankind, I have been obliged to go to Paris to carry on my research in a foreign laboratory. It will be a great blow to the progress of the science of medicine in America if any such act is passed, because it will be much more difficult for American scientists to go to foreign countries in order to do their experiments than it is for men living in England.

"I trust that the good sense of the American people will prevent any such act being passed, and I consider it the bounden duty of all American medical men who have the interests of their profession and patients at heart to oppose to the very utmost and by every means in their power the passage of any such act. Believe me

"Faithfully yours,
"T. Lauder Brunton."

The last letter is from Sir Michael Foster, member of Parliament, professor of physiology in the University of Cambridge, secretary of the Royal Society, the most distinguished physiologist of Great Britain, and one of the most distinguished in the world. No one can speak with fuller practical knowledge of the workings of the British antivivisection law than Professor Foster. The letter was written in 1890, and addressed to Professor Hodge of Clark University, Worcester, Mass.

Letter of Sir Michael Foster

"*My Dear Sir.*—It is not easy to estimate accurately the effect of the vivisection act in Great Britain. Undoubtedly during the period which has elapsed since it was passed there has been more, much more, physiological work than in the like period before the act; and on a principle not unknown to the founders of New England, viz., that persecution and difficulties engender zeal, we may look upon some of this as an unintended effect of a 'penal measure'—for so the law lords spoke of it in the House of Lords when it was being passed. On the other hand, we can only conjecture what

work might have been, had no such act been passed. Turning to the actual experience one can say that not only great annoyance, which is a very little matter, but great delay and loss of time, which is a very serious matter, have been experienced in researches which have been allowed; and quite apart from researches which have been actually forbidden by refusal of certificates and licenses. Many researches have been abandoned or let alone which would have been undertaken had there been no act. We all work on a ticket of leave. Some work is prevented, because the opportunity for work comes suddenly, unexpectedly, and before the ticket can be got, the opportunity has passed; for, though the officials do their best, I believe, to prevent unnecessary delay, a good deal of delay cannot be avoided. Again, a man undertakes a research for which he gets his ticket, but the development of his research suggests experiments not provided for in his ticket; he has to wait until his ticket is amended, or until he gets a new ticket, and while he is kicking his heels waiting for a new permission, the spirit leaves him. Again, there are some experiments, for which it is hopeless or almost hopeless to expect to get permission, and the investigator is obliged to leave his research incomplete or, if he can, go abroad and complete it. There are several instances known to me where men have gone abroad to do what is forbidden at home, and I believe that such instances are by no means uncommon. The authorities, I believe, do their best to administer the act justly, but they are laymen not understanding the nature of physiological research, and moreover are politicians, having to defend their actions in the House of Commons before a clamorous and active faction of opponents to science.

"I have just said that men go out of England to do particular experiments, and undoubtedly the act prevents men staying in England or coming to England to carry on research requiring vivisection, at least of the kind requiring special certificates. For instance, I myself can in my laboratory only offer facilities for research within the limits and under the difficulties of the act. No one in his senses who could go elsewhere would come to me to do imperfectly and under the great disadvantages what he could do freely and without hindrance elsewhere. I believe that had it not been for the act, we should have had many more men coming to work in our laboratories than we have.

"I have always said and always shall say that the necessity of a restrictive law has never been shown. The English Commission failed to demonstrate any abuse such as could justify the measures adopted, and from what I know of America and Americans I am confident that no such laws are needed with you. Indeed, my objections to the act as a politician are quite as strong as my objections as a physiologist; the act is stamped with that mark of bad statesmanship, *meddlesomeness.*

"The effect of such an act with you would be, I imagine, much as with us. It would not stop physiological work—it would worry it—it would prevent many important researches being made complete; it would lead men to follow out not the lines of research to which their ideas led them, but those which they could pursue without the restraints of licenses and certificates—it would, as with us, almost destroy the researches carried on by private individuals working apart from established laboratories, and

would certainly largely curtail the usefulness of Clark University by increasing the tendency, which you will always have to strive against, toward the predominance of pedagogy over pure research.

"The act took birth in England: 1, from the energy of *doctrinaires* of the upper middle class—the upper ten thousand had nothing to do with it—who had time and funds for public agitation, while men of science and doctors had something else to do and hated agitation; 2, because certain leaders in science and medicine, fearing the strength of the *doctrinaires,* advised a compromise—the compromise has proved to be one-sided. 'The report of the commission went beyond the evidence and the bill went beyond the report'; further, some most objectional features were added to the bill as it was being passed through Parliament at the end of a session. If the act had confined itself simply to demanding that no one should perform experiments who had not received a *general* license to do so, comparatively little harm had been done; it is the special certificates for particular kinds of experiments which give really all the trouble.

"But if the time were to come over again I would fight tooth and nail against any act at all, on the ground that all such *legislative restrictions are unnecessary,* that instances of cruelty, that is, of heedless causing of pain on the part of physiologists, are, to say the least, rare, and that public opinion aided by the ordinary law is quite sufficient to cope with such cases; (I, of course, assume that vivisection is absolutely necessary for the progress of physiology). And much as I hate public agitation, I should throw myself with all the energy I possess into agitating against such measures, sacrificing my little portion of present science for the sake of science to come. My advice to you is, accept no compromise whatever, refuse to admit for a moment the need of such a law, and fight against it everywhere, in the newspapers and on the platform, and, if the situation demands it, even imitate your opponents and refuse a political vote to a candidate who will not pledge himself to vote against it. I do not think I can say anything stronger than this last. To repeal a law is a very different thing from opposing the making of one. I scarcely think that I shall live to see the repeal of our act, but if the chance of success ever offers itself I trust I should be ready to carry out for ourselves the advice which I am now giving you.

"Yours very truly,
"M. Foster."

Such are the opinions based on actual experience, of the foremost representatives of English surgery, medicine, therapeutics, and physiology, on the effects of the only antivisection law in operation in any country, a law, moreover, bad enough but still far less repressive than that embodied in this bill. Can you wonder that biologists and physicians throughout this country are so earnest and active in their efforts to prevent the enactment of this bill? The opportunity which the introduction of this bill into Congress has afforded for an expression of the real sentiments of scientific and medical men has served to show the falsity of the assertion current in antivivisectionist's writings that there is any material division of opinion

in the medical profession concerning the utility of vivisection and the dangers to science inherent in this kind of legislation. I am aware that lists of doctors are reported in antivivisectionist's publications purporting to show that many physicians are opposed to vivisection or approve special restrictive legislation. These lists, so far as published with any fulness, contain many names which will not bear scrutiny as to their professional standing. In the most frequently cited of these lists, that collected by the American Humane Society in 1894-95, I do not see how any right thinking person could have approved the statement headed "Vivisection without Restrictions," which is as follows:

"Vivisection or experimentation upon living creatures, must be looked at simply as a method of studying the phenomena of Life. With it morality has nothing to do. It should be subject neither to criticism, supervision, nor restrictions of any kind. It may be used to any extent desired by any experimenter (no matter what degree of extreme or prolonged pain it may involve) for demonstration before students of the statements contained in their text-books, as an aid to memory; for confirmation of theories; for original research; or for any conceivable purpose of investigation into vital phenomena. We consider that sentiment has no place in the physiological laboratory; that animals have there no 'rights' which Man is called upon to notice or respect. . . ."

The comparatively small number of names signed, I must believe without due consideration, to this sorry, yes infamous, stuff is adduced by antivivisectionists as representing the proper ratio of physicians opposed to such legislative restrictions as we are considering while the large number of those who refused to sign it is cited in support of this restrictive legislation. Could anything be more unfair?

I know no one, certainly no scientific man, who believes in vivisection unrestricted by morality, uninfluenced by judicious criticism and public opinion, without competent supervision, without regard for a serious purpose in making the experiment, without due care in the avoidance of unnecessary suffering, and without subjection to the statute law relating in general to the prevention of cruelty to animals. These are the restrictions which should and do control the practice of animal experimentation. No further legislation is needed to secure them, and no special legislation regulative of this practice has ever been suggested, which would not seriously interfere with useful and proper experimentation and, therefore prove detrimental to the interests of medical science and art.

Surprise has been expressed that scientific men and the great body of the medical profession in all parts of this country should concern themselves so actively with contemplated legislation which in its immediate effects relates to a very limited area and affects directly the work of probably not

more than a dozen men, if indeed of that number. Our solicitude to prevent the passage of this act is not greater than that of antivivisectionists throughout of the country to secure it. Our opponents have hitherto signally failed in their repeated efforts to obtain the enactment of similar laws in the various states. They now seek Congressional sanction in the hope that it will promote their "Cause" throughout the country. We know, and scientific and medical men alone can fully know, the dangers to science and humanity which lurk in what may seem to some of you this unimportant bit of legislation. The medical and biological sciences have advanced in these later years with strides unapproached and in directions undreamed of but a quarter of a century ago. New vistas of knowledge and power have been disclosed, the full fruits of which will be gathered by coming generations. The main cause of this unparalleled progress in physiology, pathology, medicine and surgery has been the fruitful application of the experimental method of research, just the same method which has been the great lever of all scientific advance in modern times. Strange as it may seem at the turning point of the century, we are here, not as we should be, to ask you to foster and encourage scientific progress, but to beg you simply not to put legislative checks in its way. Our own contributions to this progress may now be small, but America is destined to take a place in this forward movement commensurate with her size and importance. We today should be recreant to a great trust, did we not do all in our power to protect our successors from the imposition of these trammels on freedom of research. Our appeal to you is not only in the name of science, but in the truest and widest sense in the name of humanity.

IS ANIMAL EXPERIMENTATION CRUEL?[1]

Although the agitation against animal experimentation has been going on for a half century and became active in this country at an earlier date than in England, comparatively little effort has been made until within the last few years by physicians and men of science to enlighten the general public upon the utility of such experimentation and the conditions of its practice and upon the objections to such prohibitory or restrictive legislation as the antivivisectionists have attempted to secure. In the meantime the field has been left open for a vigorous antivivisectionist's propaganda, which, springing from a noble sentiment, is, I believe, among movements designed to influence public opinion, unrivaled for misrepresentation, disingenuousness, credulity and misdirected sentimentality.

It speaks well for both the intelligence and the moral sense of our people that, under such circumstances, this propaganda has made, upon the whole, so little headway in this country, that so few influential newspapers have espoused the antivivisectionist's cause and that our federal and state legislators have hitherto been convinced of the evils of legislation which would deprive medicine of its most powerful lever of advancement or would seriously restrict its use.

Among the various considerations determining one's attitude toward the question of experimentation upon animals, there is none more important than that of the utility of this method of research. Even the leaders in the antivivisectionist's agitation are beginning to realize that they are engaged in a perfectly hopeless undertaking in their efforts to convince the public that animal experimentation has been and can be of little or no value to human welfare. I have sometimes wondered at the mental attitude of professed humanitarians who are so eager to collect all testimony, even the most obscure, trivial and discredited, which may make the public believe that some new remedy or improved method of treatment, such as antitoxin or antiseptic surgery, accepted by the medical profession, is of no value whatever.

No science, and the medical and biological least of all, can advance far by mere observation of natural or vital phenomena unaided by experiment. In no field of inquiry has the combination of these methods of research during the last sixty years yielded results of greater benefit to mankind than in that of medicine. Man's power to prevent the accidental infection of wounds, to control the spread of great pestilences, such as Asiatic cholera, yellow fever

[1] Leslie's Weekly, N. Y., 1911, CXII, 259.

and the plague, to exterminate malaria, to reduce the fatality of diphtheria and cerebrospinal meningitis to one-third or one-quarter of the former rate, to prevent rabies, to undertake a successful crusade against tuberculosis, the greatest scourge of mankind, has been gained almost wholly through knowledge attained, and only to be attained, by means of experiments upon animals.

Such enumerations of a few of the practical applications of scientific discovery, although quite sufficient to justify the use of animals for experimentation, give a most inadequate idea of the debt of medicine to experimental research. The best part of our knowledge of the normal functions of the body, of the circulation, of respiration, of digestion, of the secretions, has been secured by this method. Even physicians, who, like most men, rarely acquaint themselves with the sources of their knowledge, realize but little how helpless they would be in the interpretation of symptoms and the application of methods of diagnosis and of treatment if they were deprived of the physiological knowledge gained by the experimental method. But great as have been the achievements of experimental medicine, they have led us only over the threshold of the domain awaiting exploration, with the promise of greater triumphs to come.

It is impossible to suppose that the men and women who oppose animal experimentation can have any realization of the diminution in human suffering and disease which has come from this source. If they had, could even the most tender-hearted fail to see on which side of this question is the cause of mercy and humanity? I have used harsh terms in characterizing the antivivisectionist's propaganda, and I do so reluctantly, for excellent men and women have been misled into supporting it; but I believe that such terms accurately describe most of the books and leaflets and tracts spread broadcast by antivivisection societies, as well as their exhibits. These give utterly false impressions of the nature of animal experimentation and of the conditions surrounding it. The laboratories are pictured as dens of torture, the experimenters as brutes and the animals as suffering unspeakable agonies while being dissected alive.

Animal experimentation as practised today is not cruel, for cruelty is the wanton infliction of needless suffering, and in no use of animals for the benefit of man is equal solicitude exercised to avoid the infliction of unnecessary pain. Anaesthetics are used whenever the conditions of the experiment permit, and this is in the vast majority of all painful, vivisectional experiments. Operations upon an anaesthetized animal which is killed before recovering consciousness involve no more suffering than if the animal were first killed and then dissected. The great majority of physiological experiments, which are the special abhorrence of antivivisectionists, are of this character. Over ninety per cent of the experiments upon animals are not vivisections at all.

Most of the instances of alleged abuse of animal experimentation within recent years in this country, cited in antivivisectionist's writings, are not abuses at all; but I do not deny that unjustifiable and cruel experiments have been made. These, however, are today most exceptional in this country, and they do not justify the enactment of such statutes as those for which the antivivisectionists are clamoring, which would do far more harm than by any possibility good, by hampering useful and proper experimentation.

Unquestionably the practice of animal experimentation should be in proper hands; such experiments should never be done without a serious purpose and with every precaution to avoid unnecessary suffering. These are the conditions of such experimentation today in this country and they are sufficiently safeguarded by the high character and humane sentiments of the medical profession and of scientific investigators, by the general laws relating to the prevention of cruelty and by the provision in many of the laws that experiments upon animals shall be made only under the auspices of incorporated universities, medical colleges and scientific and health laboratories.

The fundamental objection to the various legislative proposals to regulate animal experimentation by a system of licenses, of inspections, of specifications as to the purposes and conduct of the experiments is that the enactment of such statutes would take the control of a matter of the highest importance to human welfare and one requiring special knowledge and training and skill out of the hands of the experts who possess these qualifications and would place it in charge of those who have not the requisite technical knowledge and experience. Not those who know, but those who do not know would be given a discretion which might prove disastrous to the future of scientific medicine. This is a monstrously wrong principle to embody in legislation. Science has waged a long warfare through the centuries for freedom of investigation. The last of its battles is being waged today for freedom of experimental research in medicine. While I do not doubt the issue of this battle, I conceive it to be the duty of the public and of the press to support the cause of freedom in this contest, which is likewise that of true humanity.

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30. Hyaline metamorphosis of the placenta. Pathological report of specimen.
In: Hyaline metamorphosis of the placenta. Death of the fetus in the fourth month and delivery of the unbroken ovum at term, by Sarah E. Post, M. D.
Tr. Am. Ass. Obst. & Gynec., Phila., 1888, i, 247-249.

31. Bulbar paralysis with muscular atrophy. (Subjects discussed: Origin of certain nerves in the medulla and fourth ventricle; Relation between amyotrophic lateral sclerosis and bulbar paralysis.)
Maryland M. J., Balt., 1888, xviii, 250.

1889

32. Hydrophobia. Report of the chairman of the Section on Anatomy, Physiology and Pathology, before the Medical and Chirurgical Faculty of Maryland, Baltimore, April 26, 1889.
Tr. M. & Chir. Fac. Maryland, Balt., 1889, 162-180; (including discussion, p. 179-180). (Reprinted.)
Also: J. Am. M. Ass., Chicago, 1889, xii, 690-692.
Also: Papers and addresses (Welch), Balt., 1920, i, 395-407.

33. Considerations concerning some external sources of infection in their bearing on preventive medicine. An address in State Medicine delivered before the American Medical Association at Newport, R. I., June 28, 1889.
Med. News Phila., 1889, lv, 29-38. (Reprinted.)
Also: Med. Rec., N. Y., 1889, xxxvi, 85-92.
Also: J. Am. M. Ass., Chicago, 1889, xiii, 73-83.
Also: Maryland M. J., Balt., 1889, xxi, 201-208; 226-234.
Also: Papers and addresses (Welch), Balt., 1920, i, 567-587.

34. Preliminary report of investigations concerning the causation of hog cholera.
Johns Hopkins Hosp. Bull., Balt., 1889-90, i, 9-10. (Reprinted.)
Also: Jahresb. ü. d. Fortschr. . . . . von d. path. Mikroorganismen [etc.], 1891, vii, 190-191.
Also: Papers and addresses (Welch), Balt., 1920, ii, 79-85.

35. Miliary aneurism of a branch of the gastric artery. Presentation of pathological specimen and report before The Johns Hopkins Hospital Medical Society, October 22, 1889.
Johns Hopkins Hosp. Bull., Balt., 1889-90, i, 12.
Also: Papers and addresses (Welch), Balt., 1920, i, 285.

36. Ovarian foetation. Report of a pathological specimen.
In: Laparotomy for ectopic pregnancy, with report of a successful case, by Thomas A. Ashby.
Maryland M. J., Balt., 1889, xxii, 305-306.

37. Multiple thrombi—multiple gangrene. (Subject discussed: Changes in composition of the blood as an etiological factor in thrombosis.)
Johns Hopkins Hosp. Bull., Balt., 1889-90, i, 12.

38. The inspection of meat and milk with special reference to tuberculosis. (Subject discussed: Inspection of meat and milk as a preventive measure against tuberculosis.)
Maryland M. J., Balt., 1889-90, xxii, 274-275.

39. Thrombosis of the cerebral sinuses and veins. (Subject discussed: blood intoxication as a factor in formation of marantic thrombi.)
Tr. Ass. Am. Physicians, Phila., 1889, iv, 74.

40. The effusion of chyle and of chyle-like milky, fatty, and oily fluids into the serous cavities. (Subject discussed: Presentation of specimen and remarks.)
Tr. Ass. Am. Physicians, Phila., 1889, iv, 102.
Also: Papers and addresses (Welch), Balt., 1920, i, 458-459.

41. A supplemental inquiry into the frequency with which lead is found in the urine. (Subject discussed: Effect of lead upon the nervous system and blood vessels.)
Tr. Ass. Am. Physicians, Phila., 1889, iv, 259.

42. How far may a cow be tuberculous before her milk becomes dangerous as an article of food? (Subject discussed: Relation of tuberculous udders of cows to transmission of the disease.)
Tr. Ass. Am. Physicians, Phila., 1889, iv, 285-286.

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43. Remarks on *Diplococcus pneumoniae.* Report of remarks (Abstr.) before The Johns Hopkins Hospital Medical Society, Baltimore, February 17, 1890.
Johns Hopkins Hosp. Bull., Balt., 1889-90, i, 73-74.
Also: Jahresb. ü. d. Fortschr. . . . . von d. path. Mikroorganismen [etc.], Brnschwg., 1891, vii, 77-78.
Also: Papers and addresses (Welch), Balt., 1920, ii, 120-123.

44. Report of a case of acute diphtheritic colitis with peri-pancreatic fat necrosis. Report of remarks made at annual meeting of the Association of American Physicians, Washington, D. C., May 13-15, 1890.
Med. News, N. Y., 1890, lvi, 566.

45. Introductory remarks concerning the study of the history of medicine. Given at meeting of The Johns Hopkins Hospital Historical Club, Baltimore, November 10, 1890.
(Not published.)

46. Pathology in its relations to general biology. An address delivered at the formal opening of the Biological Laboratory of the University of Toronto, Canada, December 20, 1889.
Johns Hopkins Hosp. Bull., Balt., 1889-90, i, 25-27. (Reprinted.)
Also: Canad. Pract., Toronto, 1890, xv, 38-43. (Reprinted.)
Also: Papers and addresses (Welch), Balt., 1920, iii, 191-199.

47. Exhibition of animal parasites (N. T.). Report of remarks before The Johns Hopkins Hospital Medical Society, Baltimore, March 17, 1890.
Johns Hopkins Hosp. Bull., Balt., 1889-90, i, 72-73. (Reprinted.)
Also: Papers and addresses (Welch), Balt., 1920, i, 536-540.

48. Specimens of papilloma and of epithelioma—so-called parasitic bodies in epithelioma. Report of remarks before The Johns Hopkins Hospital Medical Society, Baltimore, October 6, 1890.
Johns Hopkins Hosp. Bull., Balt., 1889-90, i, 97-98.
Also: Papers and addresses (Welch), Balt., 1920, i, 532-533.

49. Sudden deaths from cardiac disease. Presentation of pathological specimens and report before The Johns Hopkins Hospital Medical Society, December 2, 1889.
Johns Hopkins Hosp. Bull., Balt., 1889-90, i, 34-35.
Also: Papers and addresses (Welch), Balt., 1920, i, 288-292.

50. Hydrosalpinx. (Subject discussed: Frequency and causation of hydrosalpinx.)
Johns Hopkins Hosp. Bull., Balt., 1889-90, i, 113.

51. Tuberculosis of the lip. (Subject discussed: Brief report of a case of tuberculosis confused with epithelioma of lip.)
Johns Hopkins Hosp. Bull., Balt., 1889-90, i, 114.

52. Value of historical studies. (Subject discussed: Brief remarks as to value of medical historical studies to physicians.)
Johns Hopkins Hosp. Bull., Balt., 1889-90, i, 116.

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53. An old English translation of Regimen Sanitatis of the School of Salernum. Address given at meeting of The Johns Hopkins Hospital Historical Club, Baltimore, February 9, 1891.
(Not published.)

54. The causation of diphtheria. Annual Address before the Medical and Chirurgical Faculty of the State of Maryland, Baltimore, April 29, 1891.

Tr. M. & Chir. Fac. Maryland, Balt., 1891, 242-250. (Reprinted.)

Also: Med. News, Phila., 1891, lviii, 551-560. (Reprinted.)

Also: (Abstr.) Centralbl. f. Bakteriol. u. Parasitenk., Jena, 1892, xii, 673.

Also: (Abstr.) Jahresb. ü. d. Fortschr. . . . . von d. path. Mikroorganismen [etc.], Brnschwg., 1891, vii, 235.

Also: Papers and addresses (Welch), Balt., 1920, ii, 197-217.

55. Additional note concerning the intravenous inoculation of *Bacillus typhi abdominalis.*

Johns Hopkins Hosp. Bull., Balt., 1891, ii, 121-122.

Also: (Abstr.) Jahresb. ü. d. Fortschr. . . . . von d. path. Mikroorganismen [etc.], Brnschwg., 1891, vii, 251.

Also: Papers and addresses (Welch), Balt., 1920, ii, 332-334.

56. Conditions underlying the infection of wounds; including a discussion of disinfection with reference to treatment of wounds, of the relation of bacteria to suppuration, of the resistance of tissues to the multiplication of bacteria, and of the effects of antiseptic agents on wounds. An address delivered before the Congress of American Physicians and Surgeons, Washington, D. C., September 22, 1891.

Am. J. M. Sc., Phila., 1891, n. s., cii, 439-465. (Reprinted.)

Also: Tr. Cong. Am. Phys. & Surg., N. Haven, 1892, ii, 1-28. (Reprinted.)

Also: Maryland M. J., Balt., 1891, xxv, 534-536.

Also: (Abstr.) Jahresb. ü. d. Fortschr. . . . . von d. path. Mikroorganismen [etc.], Brnschwg., 1891, vii, 43-44.

Also: Papers and addresses (Welch), Balt., 1920, ii, 392-418.

57. Rudolf Virchow, pathologist. An address delivered at a meeting to celebrate the Seventieth Anniversary of the Birth of Professor Virchow, The Johns Hopkins University, Baltimore, October 13, 1891.

Johns Hopkins Univ. Circ., Balt., 1891, xi, 19-22.

Also: Boston M. & S. J., 1891, cxxv, 453-457. (Reprinted.)

Also: Papers and addresses (Welch), Balt., 1920, iii, 365-376.

58. Some considerations concerning antiseptic surgery. An address delivered before the Clinical Society of Maryland, Baltimore, October 16, 1891.

Maryland M. J., Balt., 1891-2, xxvi, 45-57. (Reprinted.)

Also: Papers and addresses (Welch), Balt., 1920, ii, 419-435.

59. Pre-Hippocratic Greek medicine. Address given at meeting of The Johns Hopkins Hospital Historical Club, Baltimore, November 9, 1891.
(Not published.)

60. *Bacillus coli communis;* the conditions of its invasion of the human body, and its pathogenic properties. Abstract of an address as President of the Medical and Chirurgical Faculty of Maryland, at the semi-annual meeting, Rockville, Md., November 17, 1891.
Med. News, Phila., 1891, lix, 669-671.
Also: Papers and addresses (Welch), Balt., 1920, ii, 328-331.

61. Sources of our knowledge of Hippocrates. Address given at meeting of The Johns Hopkins Hospital Historical Club, Baltimore, December 14, 1891.
(Not published.)

62. Cirrhosis hepatis anthracotica. Remarks made before The Johns Hopkins Hospital Medical Society, Baltimore, December 15, 1890.
Johns Hopkins Hosp. Bull., Balt., 1891, ii, 32-33. (Reprinted.)
Also: Papers and addresses (Welch), Balt., 1920, ii, 408-412.

63. Specimens of traumatic cerebral abscess with bacteriological examination. Report of a case before The Johns Hopkins Hospital Medical Society, Baltimore, November 3, 1890.
Johns Hopkins Hosp. Bull., Balt., 1891, ii, 141-142.
Also: Papers and addresses (Welch), Balt., 1920, ii, 389-391.

64. Duplicature of arch of aorta with aneurism. Presentation of pathological specimen and report before The Johns Hopkins Hospital Medical Society, Baltimore, February 2, 1891.
Johns Hopkins Hosp. Bull., Balt., 1891, ii, 142.
Also: Papers and addresses (Welch), Balt., 1920, i, 286-287.

65. A case of pancreatitis with fat necroses. (Specimen.) The Johns Hopkins Hospital Medical Society, March 16, 1891.
(Not published.)

66. Manual of Clinical diagnosis. By Dr. Otto Seifert and Dr. Friedrich Müller. 2. Eng. ed. 1890, G. P. Putnam's Sons. (Book review.)
Johns Hopkins Hosp. Bull., Balt., 1891, ii, 106.

67. An Illustrated Encyclopaedic Medical Dictionary. By Frank P. Foster, M. D., with collaborators. Vol. I, and Vol. II. New York, 1888 and 1890, D. Appleton & Co. (Book review.)
Johns Hopkins Hosp. Bull., Balt., 1891, ii, 114.

68. Ruptured right tubal pregnancy, associated with perforation of the vermiform appendix, confirmatory diagnosis by aspiration; operation; death. (Subject discussed: Sudden collapse and death following rapid removal of increased intraabdominal pressure.)
Johns Hopkins Hosp. Bull., Balt., 1891, ii, 139-140.

69. The frequency of the localization of *phthisis pulmonalis* in the upper lobes. (Subject discussed: Modes of production of apical tuberculosis and favorable condition in apex for growth of tubercle bacilli.)
Tr. Ass. Am. Physicians, Phila., 1891, vi, 52.

70. A case of slow pulse. (Subject discussed: Variability in size and position of ganglionic swellings on cardiac nerves.)
Tr. Ass. Am. Physicians, Phila., 1891, vi, 261.

71. On changes in red blood corpuscles in the pernicious anaemia of Texas cattle fever. (Subject discussed: Similarity of some of the changes in red corpuscles of Texas cattle fever to those in human cases of severe anaemia.)
Tr. Ass. Am. Physicians, Phila., 1891, vi, 277-278.

72. Grave forms of purpura haemorrhagica. (Subject discussed: Brief remarks on white staphylococcus in the skin.)
Tr. Ass. Am. Physicians, Phila., 1891, vi, 290.

Welch, W. H. and Abbott, A. C.

73. The etiology of diphtheria. The results of the investigations reported in this paper were communicated to The Johns Hopkins Hospital Medical Society, Baltimore, June 2, 1890, and January 9, 1891.
Johns Hopkins Hosp. Bull., Balt., 1891, ii, 25-31. (Reprinted.)
Also: (Abstr.) Centralbl. f. Bakteriol. u. Parasitenk., Jena, 1892, xi, 55.
Also: (Abstr.) Jahresb. ü. d. Fortschr. . . . . von d. path. Mikroorganismen [etc.], 1891, vii, 223.
Also: Papers and addresses (Welch), Balt., 1920, ii, 181-196.

Welch, W. H. and Flexner, S.

74. The histological changes in experimental diphtheria. Preliminary communication before The Johns Hopkins Medical Society, May, 1891.
Johns Hopkins Hosp. Bull., Balt., 1891, ii, 107-110. (Reprinted.)
Also: (Abstr.) Jahresb. ü. d. Fortschr. . . . . von d. path. Mikroorganismen [etc.], 1891, vii, 232-233.
Also: Papers and addresses (Welch), Balt., 1920, ii, 218-224.

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75. The schools of Cos and Cnidus. Address given at meeting of The Johns Hopkins Hospital Historical Club, Baltimore, January 11, 1892.
    (Not published.)
76. *Micrococcus lanceolatus,* with especial reference to the etiology of acute lobar pneumonia. An article based upon lectures on the causation of acute lobar pneumonia, delivered at The Johns Hopkins Hospital in January, February and March, 1892—and upon his presidential address before the Medical and Chirurgical Faculty of Maryland, Baltimore, April, 1892.
    Johns Hopkins Hosp. Bull., Balt., 1892, iii, 125-139.
    Also: (Abstr.) Jahresb. ü. d. Fortschr. . . . . von d. path. Mikroorganismen [etc.], Brnschwg., 1892, viii, 47-48.
    Also: Papers and addresses (Welch), Balt., 1920, ii, 146-180.
    Also: (Abstr.) Schmidt's Jahrb. Leipz., 1893, ccxxxviii, 242.
77. The etiology of acute lobar pneumonia, considered from a bacteriological point of view. President's address before the Medical and Chirurgical Faculty of Maryland, Baltimore, April 26, 1892.
    Tr. M. & Chir. Fac. Maryland, Balt., 1892, 1-29. (Reprinted.)
    Also: Med. Rec., N. Y., 1892, xli, 584-585.
    Also: Papers and addresses (Welch), Balt., 1920, ii, 124-145.
78. The advancement of medical education [N. T.]. Remarks made at the annual dinner of the Harvard Medical School Association, June, 1892.
    Bull. Harv. M. Sch. Ass., Bost., 1892, 55-64.
    Also: Papers and addresses (Welch), Balt., 1920, iii, 41-45.
79. Carcinoma of kidney, with secondary growths in the ureter and bladder. The Johns Hopkins Hospital Medical Society, Baltimore, February 1, 1892.
    (Not published.)
80. Chronic fibrous inflammation of serous membranes, with exhibition of specimens. The Johns Hopkins Hospital Medical Society, Baltimore, May 23, 1892.
    (Not published.)
81. Specimen of otomycosis aspergillina. Report of presentation of a specimen before The Johns Hopkins Hospital Medical Society, Baltimore, October 17, 1892.
    Johns Hopkins Hosp. Bull., Balt., 1892, iii, 122.
82. Aneurism with demonstration of bacillus causing air in the tissues. Demonstration of specimen and new microorganism before The Johns Hopkins Hospital Medical Society, November 2, 1891.
    Johns Hopkins Hosp. Bull., Balt., 1892, iii, 31.

83. Demonstration of cultures of comma bacilli, including those of Asiatic cholera. The Johns Hopkins Hospital Medical Society, Baltimore, December 5, 1892.
(Not published.)
84. The principles of bacteriology; a practical manual for students and physicians, by A. C. Abbott. Phila., 1892, Lea Bros. & Co., 263 p. 8°. (Book review.)
Johns Hopkins Hosp. Bull., Balt., 1892, iii, 16.
85. The principles and practice of medicine, designed for the use of practitioners and students of medicine, by William Osler. New York, 1892, D. Appleton & Co., 1095 p. 8°. (Book review.)
Johns Hopkins Hosp. Bull., Balt., 1892, iii, 46.
86. A history of epidemics in Britain from A. D. 664 to the extinction of plague, by Charles Creighton, Cambridge, 1891, at the University Press, xii, 706 p. 8°. (Book review.)
Johns Hopkins Hosp. Bull., Balt., 1892, iii, 95-96.
87. Cholesteatoma or pearl tumor of the ear. (Subject discussed: Theories of origin of cholesteatoma.)
Maryland M. J., Balt., 1892, xxvi 232.
88. A bacteriological study of drinking-water. (Subjects discussed: Distinction between toxicogenic and pathogenic germs; Typhoid-like organism in drinking-water; Confusion of *Bacillus coli communis* with Eberth's bacillus.)
Tr. Ass. Am. Physicians, Phila., 1892, vii, 40-42.
89. Practical results of bacteriological researches. (Subject discussed: Therapeutic value of blood serum of immunized animals in its practical application to human disease.)
Tr. Ass. Am. Physicians, Phila., 1892, vii, 84-85.
90. The treatment of experimental tuberculosis by Koch's tuberculin, Hunter's modifications, and other products of the tubercle bacillus. (Subject discussed: Trudeau's experiments with bacterio-proteins in tubercle bacilli and use of simple filtrate of liquid tubercle cultures.)
Tr. Ass. Am. Physicians, Phila., 1892, vii, 101.

Welch, W. H. and Flexner, S.
91. The histological lesions produced by the toxalbumen of diphtheria.
Johns Hopkins Hosp. Bull., Balt., 1892, iii, 17-18. (Reprinted.)
Also: (Abstr.) Centralbl. f. Bakteriol. u. Parasitenk., Jena, 1892, xii, 871-872.
Also: (Abstr.) Jahresb. ü. d. Fortschr. . . . . von d. path. Mikroorganismen [etc.], Brnschwg., 1892, viii, 190.
Also: Papers and addresses (Welch), Balt., 1920, ii, 225-228.

Welch, W. H. and Nuttall, G. H. F.

92. A gas-producing bacillus (*Bacillus aerogenes capsulatus,* nov. spec.), capable of rapid development in the blood-vessels after death.
    Johns Hopkins Hosp. Bull., Balt., 1892, iii, 81-91. (Reprinted.)
    Also: (Abstr.) Jahresb. ü. d. Fortschr. . . . . von d. path. Mikroorganismen [etc.], Brnschwg., 1892, viii, 303.
    Also: Papers and addresses (Welch), Balt., 1920, ii, 539-563.

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93. Sanitation in relation to the poor. An address delivered before the Charity Organization Society of Baltimore, November 14, 1892. Charities Review 1893, February.
    Also: Eleventh Ann. Rep., Charity Organization Soc., Balt., (1892), 1893, 22-35. (Reprinted.)
    Also: Papers and addresses (Welch), Balt., 1920, i, 588-598.
94. Asiatic cholera in its relations to sanitary reforms.
    Pop. Health Mag., Wash., 1893-94, i, 6-12. (Reprinted.)
    Also: Papers and addresses (Welch), Balt., 1920, i, 599-606.
95. Introduction to the study of Galen. Address given at meeting of The Johns Hopkins Hospital Historical Club, Baltimore, March 13, 1893.
    (Not published.)
96. The Johns Hopkins Medical School. An address delivered at the graduating exercises of The Johns Hopkins University, Baltimore, June 13, 1893.
    Balt., 1893, 6 p., 8°.
    Also: Papers and addresses (Welch), Balt., 1920, iii, 9-13.
97. Medullary form of sarcoma of the sternum, with metastases in the lymphatic glands. Report of a case before The Johns Hopkins Hospital Medical Society, Baltimore, December 4, 1893.
    Johns Hopkins Hosp. Bull., Balt., 1893, iv, 103-105.
    Also: Papers and addresses (Welch), Balt., 1920, i, 434-439.
98. Studies in diphtheria. (Subjects discussed: Development of diphtheria bacilli at a distance from point of inoculation; A case of vegetative endocarditis due to diphtheria bacillus.)
    Johns Hopkins Hosp. Bull., Balt., 1893, iv, 33-34.
99. A study of Addison's disease of the adrenals. (Subject discussed: Brief report of six cases of Addison's disease with tuberculosis of the adrenals.)
    Tr. Ass. Am. Physicians, Phila., 1893, viii, 58-59.

100. Note on use of quinine in chorea. (Subject discussed: Search for organisms in the blood of dogs with cholera.)
Tr. Ass. Am. Physicians, Phila., 1893, viii, 106.

101. Eye tuberculosis and antitubercular inoculation in the rabbit. (Subject discussed: Report of experimental results of inoculation in three rabbits.)
Tr. Ass. Am. Physicians, Phila., 1893, viii, 113-114.
Also: Papers and addresses (Welch), Balt., 1920, ii, 638-640.

102. Some problems in the etiology and pathology of Texas cattle fever and their bearing on the comparative study of protozoan diseases. (Subject discussed: Theobald Smith and the assistance of governmental support in clearing up the etiology of Texas cattle fever.)
Tr. Ass. Am. Physicians, Phila., 1893, viii, 134.

103. Sarcoma of the right lung diagnosticated during life by the use of the microscope: secondary to sarcoma of the testicle which had been removed four years previously. (Subject discussed: Brief remarks on diagnosis of malignant growth of lung from microscopic examination of aspiration material.)
Tr. Ass. Am. Physicians, Phila., 1893, viii, 194.

104. Cases of subphrenic abscess. (Subjects discussed: *Bacillus coli communis* in abscesses communicating with stomach and intestines; Relation of direction of lymph current to production of subphrenic abscess.)
Tr. Ass. Am. Physicians, Phila., 1893, viii, 265-266.

105. Report of a case of myxoedema. (Subjects discussed: Changes in the thyroid of dogs by repeated partial excision of the gland; Report of examination of thyroid glands of 100 dogs.)
Tr. Ass. Am. Physicians, Phila., 1893, viii, 377-378.

Welch, W. H. and Ewing, C. B.

106. The action of rattlesnake venom upon the bactericidal properties of the blood. Report of remarks before the Section on Pathology of the Pan-American Medical Congress, Washington, D. C., September 6, 1893.
Tr. Pan-Am. M. Cong., Wash., 1893, i, 354-355.
Also: Lancet, Lond., 1894, i, 1236.
Also: Papers and addresses (Welch), Balt., 1920, ii, 358.

Welch, W. H. and Smith, F. R.

107. Diffuse infiltrating carcinoma of the stomach. Report of a case before The Johns Hopkins Hospital Medical Soc., Baltimore, May 15, 1893.
Johns Hopkins Hosp. Bull., Balt., 1893, iv, 98-99.
Also: Papers and addresses (Welch), Balt., 1920, i, 440-443.

1894

108. General considerations concerning the biology of bacteria, infection and immunity.
In: Theory & Pract. M. (Pepper). Phila., 1894, ii, 1-69. (Reprinted.)
Also: Papers and addresses (Welch), Balt., 1920, ii, 3-78.

109. Higher medical education and the need of its endowment. An address delivered at the Graduating Exercises and Fiftieth Anniversary of the Medical Department of the Western Reserve University, Cleveland, Ohio, February 28, 1894.
Med. News, Phila., 1894, lxv, 63-70. (Reprinted.)
Also: Papers and addresses (Welch), Balt., 1920, iii, 46-62.

110. "Carcinoma originating in Brunner's glands." The Johns Hopkins Hospital Medical Society, March 19, 1894.
(Not published.)

111. Analysis of a bacteriological study of 500 autopsies at The Johns Hopkins Hospital. Middleton Goldsmith Lecture delivered before the New York Pathological Society, New York City, April, 1894.
(Unpublished.)

112. Bacteriological investigations of diphtheria in the United States. A report in behalf of the American Committee on Diphtheria to the Eighth International Congress of Hygiene and Demography, held in Budapest, September 1 to 9, 1894.
Am. J. M. Sc., Phila., 1894, n. s., cviii, 427-461. (Reprinted.)
Also: (Abstr.) Centralbl. f. Bakteriol. u. Parasitenk., Jena, 1894, xvi, 961-962.
Also: Papers and addresses (Welch), Balt., 1920, ii, 229-264.

113. Papillomata of the ovary. (Subject discussed: Papillomata a distinct type of tumor, originating from graafian follicle.)
Johns Hopkins Hosp. Bull., Balt., 1894, v, 68.

114. Sarcoma in the floor of the mouth. Excision followed by hypertrophy of the left submaxillary gland. (Subject discussed: Enlargement of secreting gland with chronic inflammation following occlusion of its duct.)
Johns Hopkins Hosp. Bull., Balt., 1894, v, 120.

115. A case of typhoid septicaemia associated with focal abscesses in the kidneys, due to the typhoid-bacillus. (Subjects discussed: Occasional occurrence of human cases of typhoid septicaemia with overwhelming numbers of bacilli in the blood; Formation of pure typhoid bacillus

abscess; Typhoid bacilli viable in osteomyelitis and gall-bladder for months and years.)
Johns Hopkins Hosp. Bull., Balt., 1894, v, 121.

116. Sewer gas a cause of throat disease (or the effect of bad drainage on the throat). (Subject discussed: Relation of diphtheria to sewer gas.)
Tr. Cong. Am. Phys. & Surg., N. Haven, 1894, iii, 101-102.

117. Clinical report of two cases of Raynaud's disease. (Subject discussed: Cause of haemoglobinuria in Raynaud's disease.)
Tr. Ass. Am. Physicians, Phila., 1894, ix, 73.

118. Investigations upon cow-pox. (Subject discussed: Need for repeating investigations upon cow-pox.)
Tr. Ass. Am. Physicians, Phila., 1894, ix, 84.

119. Modification, temporary and permanent, of the physiological characters of bacteria in mixed cultures. (Subjects discussed: Artificial modification of bacteria is one of function and not morphology; Bacteria do not ordinarily exist in nature in pure culture; Metchnikoff and Selander probably worked with bacillus of rabbit septicaemic group rather than with bacillus of hog cholera.)
Tr. Ass. Am. Physicians, Phila., 1894, ix, 108-109.

120. The effects of various metals on the growth of certain bacteria. (Subjects discussed: Minimal amount of metal as favorable to the growth of bacteria; Larger quantities of metals as poisonous to bacteria.)
Tr. Ass. Am. Physicians, Phila., 1894, ix, 184.

Welch, W. H. and Clement, A. W.

121. Remarks on hog cholera and swine plague. Delivered before the First International Veterinary Congress of America, Chicago, Ill., October 20, 1893.
Phila., 1894, 37 p., 8°.
Also: Vet. J. & Ann. Comp. Path., Lond., 1894, xxxix, 235; 324. (Reprinted.)
Also: (Abstr.), Jahresb. ü. d. Fortschr. . . . . von d. path. Mikroorganismen [etc.], Brnschwg., 1893, ix, 135-137; 1894, x, 157-158.
Also: Papers and addresses (Welch), Balt., 1920, ii, 86-119.

1895

122. General bacteriology of surgical infections.
In: Syst. Surg. (Dennis), Phila., 1895, i, 249-334. (Reprinted.)
Also: Papers and addresses (Welch), Balt., 1920 ii, 436-538.

123. Pseudo-tuberculosis in animals. The Johns Hopkins Hospital Medical Society, Baltimore, February 4, 1895.
(Not published.)

124. Recent researches on immunity. Paper given at One Hundred and Twenty-First Meeting of the Scientific Association of The Johns Hopkins University, Baltimore, April 25, 1895.
(Abstr.) Johns Hopkins Univ. Circ., Balt., 1894-95, xiv, 70.

125. The treatment of diphtheria by antitoxin. This paper is based upon an address made by the writer at the opening of the discussion on this subject before the Association of American Physicians, Washington, D. C., May 30, 1895.
Johns Hopkins Hosp. Bull., Balt., 1895, vi, 97-120.
Also: Tr. Ass. Am. Physicians, Phila., 1895, x, 312-384. (Reprinted.)
Also: Proc. Connect. M. Soc., Bridgeport, Conn., 1895, 261-295. (Reprinted.)
Also: (Abstr.) Centralbl. f. Bakteriol. u. Parasitenk., Jena, 1895, xviii, 567-568.
Also: (Abstr.) Maryland M. J., Balt., 1895, xxxiii, 480-481.
Also: (Abstr.) Med. Rec., N. Y. 1895, xlvii, 754.
Also: (Abstr.) Jahresb. ü. d. Fortschr. . . . . von d. path. Mikroorganismen [etc.], Brnschwg., 1895, xi, 243-244.
Also: Papers and addresses (Welch), Balt., 1920, ii, 265-321.

126. Remarks as chairman of the convention. Report of various remarks as chairman of the first Convention of Bacteriologists under the auspices of the Committee on the Pollution of Water Supplies of the American Public Health Association, New York City, June 21-22, 1895.
Am. Pub. Health Ass., Rep., Concord, N. H., 1895, xx, 459-516.

127. What shall be the mode of procedure in determining the pathogenesis of bacteria found in water? Address before the Convention of Bacteriologists, under the auspices of the Committee on the Pollution of Water Supplies of the American Public Health Association, New York City, June 21, 1895.
Am. Pub. Health Ass., Rep., Concord, N. H., 1895, xx, 502-516.
Also: Papers and addresses (Welch), Balt., 1920, ii, 645-654.

128. The evolution of modern scientific laboratories. An address delivered at the opening of the William Pepper Laboratory of Clinical Medicine, Philadelphia, December 4, 1895.
William Pepper Lab. Clin. Med. (Proc.), Phila., 1895, no. 2, 17-31. (Reprinted.)
Also: Johns Hopkins Hosp. Bull., Balt., 1896, vii, 19-24. (Reprinted.)
Also: Rep. Smithson. Inst., 1895, Wash., 1896, 493-504. (Reprinted.)
Also: Papers and addresses (Welch), Balt., 1920, iii, 200-211.

129. Catheterization of the ureters in the male. (Subject discussed: Report of a diagnosis of congenital unilateral kidney in a male, made by examination of the specimen removed by surgeon, at a period before catheterization of ureters was practised.)
Johns Hopkins Hosp. Bull., Balt., 1895, vi, 16.
Also: Papers and addresses (Welch), Balt., 1920, i, 460.

130. Pyarthrosis. (Subjects discussed: Disinfection of surfaces of the body; Occurrence of gas bacillus outside of human body.)
Johns Hopkins Hosp. Bull., Balt., 1895, vi, 145.

131. Typhoid fever in country districts. (Subjects discussed: Difficulty to trace exact origin of infection; Importance of sanitation and preventive measures.)
Maryland M. J., Balt., 1895, xxxiii, 64-65.

132. Relation existing between gall stones and hepatic abscess. (Subjects discussed: Bacteria directly from duodenum into bile passages; *Bacillus coli communis* in gall stones.)
Maryland M. J., Balt., 1895, xxxiii, 66.

133. Gonorrhoeal arthritis. Clinical observations. (Subjects discussed: Various complicating lesions produced by gonococci; Report of a case of gonorrhoeal suppurative tendo-vaginitis; A case of gonorrhoeal ulcerative endocarditis and septicaemia.)
Tr. Ass. Am. Physicians, Phila., 1895, x, 151-154.
Also: Maryland M. J., Balt., 1895, xxxiii, 154.
Also: Med. Rec., N. Y., 1895, xlvii, 756.
Also: (Abstr.) Jahresb. ü. d. Fortschr. . . . . von d. path. Mikroorganismen [etc.], Brnschwg., 1895, xi, 115, 118.

134. Hyperthermy in a man up to 148° F. (64.4° C.). (Subject discussed: Report of famous case of temperature deception to 151° and 171° F., observed by Dr. W. J. Galbraith, Omaha, Nebraska.)
Tr. Ass. Am. Physicians, Phila., 1895, x, 189-191.
Also: Papers and addresses (Welch), Balt., 1920, i, 367-369.

Welch, W. H. and Flexner, S.

135. An additional report upon *Bacillus aerogenes capsulatus.* The Johns Hopkins Hospital Medical Society, Baltimore, March 18, 1895.
(Not published.)

1896

136. The influence of anaesthesia upon medical science. Remarks made October 16, 1896, at the Commemoration of the Fiftieth Anniversary of the First Public Demonstration of Surgical Anaesthesia at the Mass. Gen. Hosp., Boston.

Boston M. & S. J., 1896, cxxxv, 401-403. (Reprinted.)
In: Semi-Centen. Anaesthesia, Bost., 1897, 59-68.
Also: Papers and addresses (Welch), Balt., 1920, iii, 215-220.

137. Animal experimentation in the writings of Galen. Address given at The Johns Hopkins Hospital Historical Club, Baltimore, December 14, 1896.
(Not published.)

138. Journal of Experimental Medicine, 1896, vol. I. (Introduction.)
J. Exper. M., N. Y., 1896, i, 1-3.
Also: Papers and addresses (Welch), Balt., 1920, iii, 212-214.

139. Actinomycosis of the appendix vermiformis and liver. The Johns Hopkins Hospital Medical Society, March 16, 1896.
(Not published.)

140. Intestinal and hepatic actinomycosis, associated with leukaemia. (N. T.) Report on a pathological specimen.
In: A case of intestinal and hepatic actinomycosis in man, associated with leukaemia, by Thomas S. Latimer, Baltimore.
Tr. Ass. Am. Physicians, Phila., 1896, xi, 328-339. (Reprinted.)
Also: Internat. Clin., Phila., 1896, 6. s., iii, 152-164.
Also: Papers and addresses (Welch), Balt., 1920, i, 541-545.

141. Some investigations as to the virulence of the diphtheria bacilli occasionally found in the throat secretions in cases presenting the clinical features of simple acute angina. (Subject discussed: Percentage of genuine diphtheria cases diagnosed by practitioners.)
Tr. Ass. Am. Physicians, Phila., 1896, xi, 259.

142. Prognosis in pneumonia. (Subjects discussed: Protective influence of high fever; Injury of high fever to microorganisms.)
Tr. Ass. Am. Physicians, Phila., 1896, xi, 270.

143. A case of leukaemia. (Subject discussed: Large bone marrow cells with irregular, budding neuclei found in blood vessels in a case of splenic myelogenous leukaemia.)
Tr. Ass. Am. Physicians, Phila., 1896, xi, 316.

Welch, W. H. & Flexner, S.

144. Observations concerning *Bacillus aerogenes capsulatus.*
J. Exper. M., N. Y., 1896, i, 5-45.
Also: (Abstr.), Jahresb. ü. d. Fortschr. . . . . von d. path. Mikroorganismen [etc.], Brnschwg., 1896, xii, 494.
Also: Papers and addresses (Welch), Balt., 1920, ii, 564-598.

1897

145. Animal experimentation in the period between Galen and Harvey. Address given at The Johns Hopkins Hospital Historical Club, Baltimore, January 11, 1897.
    (Not published.)
146. Clinical and bacteriological diagnosis of diphtheria. Remarks made at the Conference of Health Officers, Baltimore, February 17-18, 1897.
    Maryland M. J., Balt., 1896-97, xxxvi, 392-395. (Reprinted.)
    Also: Papers and addresses (Welch), Balt., 1920, ii, 322-327.
147. Opening remarks by the President at Congress of American Physicians and Surgeons, Washington, D. C., May 4, 1897. (Report of remarks.)
    Tr. Cong. Am. Phys. & Surg., N. Haven, 1897, iv, p. xvii.
148. Adaptation in pathological processes. President's address before the Congress of American Physicians and Surgeons, Washington, D. C., May 5, 1897.
    Tr. Cong. Am. Phys. & Surg., N. Haven, 1897, iv, 284-310. (Reprinted.)
    Also: Am. J. M. Sc., Phila., 1897, n. s., cxiii, 631-655.
    Also: Science, N. Y. & Lancaster, Pa., 1897, n. s., v, 813-832. (Reprinted.)
    Also: Papers and addresses (Welch), Balt., 1920, i, 370-394.
149. Closing remarks by the President at Congress of American Physicians and Surgeons, Washington, D. C., May 6, 1897. (Report of remarks.)
    Tr. Cong. Am. Phys. & Surg., N. Haven, 1897, iv, p. xxii.
150. Principles underlying the serum diagnosis of typhoid fever and the methods of its application. Presented in opening the discussion on serum diagnosis in the Section on Practice of Medicine, at the Forty-Eighth Annual Meeting of the American Medical Association, at Philadelphia, June 1-4, 1897.
    Chicago, 1897, Am. M. Ass., Press, 32 p. 8°.
    Also: J. Am. M. Ass., Chicago, 1897, xxix, 301-309; (Discussion) 313-315. (Reprinted.)
    Also: Am. Med.-Surg. Bull., N. Y., 1897, xi, 779-792.
    Also: (Abstr.), Jahresb. ü. d. Fortschr. . . . . von d. path. Mikroorganismen [etc.], 1897, xiii, 374.
    Also: Papers and addresses (Welch), Balt., 1920, ii, 336-357.
151. Biology and medicine. Address delivered at the dedication of the Hull Biological Laboratories at the University of Chicago, July 2, 1897.
    Am. Naturalist, Phila., 1897, xxxi, 755-766. (Reprinted.)

Also: University Record, Chicago, 1897, ii, 141-146. (Reprinted.)
Also: Papers and addresses (Welch), Balt., 1920, iii, 234-242.

152. American Public Health Association. Procedures recommended for the study of bacteria, with especial reference to greater uniformity in the description and differentiation of species. Being the report of a Committee of American Bacteriologists to the Committee on the Pollution of Water Supplies. Submitted at the meeting of the Association in Phila., Pa., September 1897. (Introduction.)
Concord, N. H., 1898, 47 p. 8°.

153. Examination of an intermuscular mixed tumor from the arm. (Report of a pathological specimen.)
(MS. not published.)

154. Is malaria a water-borne disease? (Subjects discussed: Infectious diseases conveyed by drinking water; Air infection and mosquito inoculation theories of malaria.)
Johns Hopkins Hosp. Bull., Balt., 1897, viii, 42-43.

155. Excision of a parovarian cyst without removal of its ovary or tube. (Subject discussed: Frequency with which Fallopian tubes are closely attached to parovarian cysts.)
Johns Hopkins Hosp. Bull., Balt., 1897, viii, 51.

156. On the haemocytozoa of birds. (Subject discussed: Features distinguishing haemocytozoa of birds from malarial organisms.)
Johns Hopkins Hosp. Bull., Balt., 1897, viii, 53.

157. Rabies. (Subjects discussed: Treatment and prevention of rabies; Method of diagnosis.)
Maryland M. J., Balt., 1897, xxxviii, 7-9; 1897, xxxvii, 209.

158. On the occurrence of the fat-splitting ferment in peritoneal fat necroses and the histology of these lesions. (Subject discussed: Colon bacilli as accidental invaders in pancreatic fat necroses.)
Tr. Ass. Am. Physicians, Phila., 1897, xii, 290.

159. Acute general peritonitis. The prognosis and treatment. (Subjects discussed: Distribution of peritonitis and organisms in peritonitis; Methods of bacteriological diagnosis, considering, for practical purposes, all cases as bacteriological.)
Tr. Cong. Am. Phys. & Surg., N. Haven, 1897, iv, 282-283.

Welch, W. H. and Thayer, W. S.

160. Malaria. [History & parasitology.]
In: Syst. Pract. M. (Loomis), N. Y., & Phila., 1897, i, 17-154. (Reprinted.)
Also: (Abstr.) Centralbl. f. Bakteriol. u. Parasitenk., Jena, 1898, I. Abt., xxiv, 894.
Also: Papers and addresses (Welch), Balt., 1920, i, 463-531.

1898

161. The relation of sewage disposal to public health. Remarks made at the joint meeting of the Medical and Chirurgical Faculty of Maryland and the Maryland Public Health Association, to discuss the sewerage of Baltimore, November 19, 1897.
Maryland M. J., Balt., 1897-98, xxxviii, 199-204. (Reprinted.)
Also: (Abstr.) Health Mag., Balt., Wash., N. Y., 1897-98, v-vi, 196-198.
Also: (Abstr.) Sanitary Rec., Lond., 1898, xxi, 395-396.
Also: (Abstr.) J. Am. M. Ass., Chicago, 1898, xxxi, 482.
Also: Papers and addresses (Welch), Balt., 1920, i, 607-614.

162. Recent investigation concerning the sources of Hippocratic medicine. Address given at meeting of The Johns Hopkins Hospital Historical Club, Baltimore, January 10, 1898.
(Not published.)

163. Reply to the statements made by the president of the Washington Humane Society in a letter addressed by him to each Senator of the United States.
J. Am. M. Ass., Chicago, 1898, xxx, 677-679. (Reprinted.)

164. Objections to the antivivisection bill now before the Senate of the United States. Prepared to meet the requests of several Senators of the United States and of physicians as objections to Senate Bill 1063.
J. Am. M. Ass., Chicago, 1898, xxx, 285-289. (Reprinted.)
Also: Papers and addresses (Welch), Balt., 1920, iii, 455-468.

165. Remarks as president. Report of remarks as president of the Maryland Public Health Association, Baltimore, May 11-12, 1898.
Maryland M. J., Balt., 1898, xxxix, 651-654.

166. Remarks at the presentation of the candidates for the degree of Doctor of Medicine at the commencement of The Johns Hopkins University, June 14, 1898.
Johns Hopkins Hosp. Bull., Balt., 1898, ix, 151-154. (Reprinted.)
Also: Papers and addresses (Welch), Balt., 1920, iii, 14-19.

167. Anniversary discourse; Landmarks in the history of pathology. Report of an address delivered at the Anniversary Meeting of New York Academy of Medicine, New York City, November 17, 1898.
Med. Rec., N. Y., 1898, liv, 778-779.

168. Memorial protesting against the passage of Senate Bill 1063, entitled "A bill for the further prevention of cruelty to animals in the District of Columbia," January 31, 1898. [letter]
55th Cong., 2d. Sess., Senate Doc. 104. Wash., 1898, II p. 8°.

169. Medical practice act. Letter to editor of the Maryland Medical Journal, Baltimore, March 12, 1898.
Maryland M. J., Balt., 1898, xxxviii, 410.

170. Melano-sarcoma. Brief report of a case and exhibition of pathological specimen, before the Clinical Society of Maryland, Baltimore, October 15, 1897.
Maryland M. J., Balt., 1898, xxxviii, 266-267.

171. Public school conditions, problems and methods. (Subjects discussed: Physiological aspect of exercise; How does exercise act physiologically?)
Health Mag., Wash., Balt., N. Y., 1897-98, v-vi, 351.

172. The presence in the blood of free granules derived from leucocytes, and their possible relations to immunity. (Subject discussed: Value of this theory of immunity as a working hypothesis.)
Johns Hopkins Hosp. Bull., Balt., 1898, ix, 18.

173. On the haematozoan infection of birds. (Subject discussed: Importance of the result of this experimental work on haematozoan infection of birds.)
Johns Hopkins Hosp. Bull., Balt., 1898, ix, 18.

174. Cerebro-spinal meningitis. (Subjects discussed: Historical development of our knowledge concerning *Meningococcus intracellularis;* The so-called cerebrospinal meningitis in horses.)
Johns Hopkins Hosp. Bull., Balt., 1898, ix, 31-32.

175. The bacteriology of pertussis. (Subject discussed: Polar and irregular staining of bacteria.)
Johns Hopkins Hosp. Bull., Balt., 1898, ix, 82.

176. The bacteriology of yellow fever. (Subjects discussed: Failure of sublimate solution to kill bacteria; Arguments against Sanarelli's bacillus as an etiological factor of yellow fever.)
Johns Hopkins Hosp. Bull., Balt., 1898, ix, 119-120.

177. Antitoxine treatment of pneumonia. (Subjects discussed: Brief report of experiments on the toxines in the blood of pneumonia patients and patients convalescing from pneumonia; Injection of living organisms not likely to lead to an antitoxine.)
Maryland M. J., Balt., 1899, xxxix, 631.

178. An experimental study of the direct inoculation of bacteria into the spleen of living animals. (Subjects discussed: Doctrine of *locus minoris resistentiae;* Bactericidal properties of the spleen.)
Tr. Ass. Am. Physicians, Phila., 1898, xiii, 58.

179. A case of two isolated carcinomatous gastric ulcers. (Subjects discussed: Discrepancy in diagnosis of the case; Multiple cancers in the stomach as probably due to implantation.)
Tr. Ass. Am. Physicians, Phila., 1898, xiii, 295.
180. Acute interstitial nephritis. (Subject discussed: Migration of lymphoid cells.)
Tr. Ass. Am. Physicians, Phila., 1898, xiii, 325.

1899

181. Thrombosis and embolism.
In: Syst. Med. (Allbutt), Lond., 1899, vii, 155-285. (Reprinted.)
Also: Syst. Med. (Allbutt & Rolleston), Lond., 1909, vi, 691-821.
Also: Papers and addresses (Welch), Balt., 1920, i, 110-258.
182. Epoch in the development of pathology. Address given at meeting of The Johns Hopkins Hospital Historical Club, Baltimore, March 13, 1899.
(Not published.)
183. Recent contributions to the theories of immunity. Report of remarks made before the Clinical Society of Maryland, Baltimore, April 7, 1899.
Maryland M. J., Balt., 1899, xli, 228-230.
Also: Canad. Pract. & Rev., Toronto, 1899, xxiv, 311-318.
184. History of the doctrines of fever. Address given at meeting of The Johns Hopkins Hospital Historical Club, Baltimore, April 9, 1899.
(Not published.)
185. Description of exhibit of works and portraits to illustrate epochs in medicine. Report of remarks on an exhibition of works and portraits to illustrate epochs in the history of medicine, made at the Centennial Anniversary of the Medical and Chirurgical Faculty of the State of Maryland, McCoy Hall, The Johns Hopkins University, Baltimore, April 26, 1899.
Tr. M. & Chir. Fac. Maryland, Balt., 1897-1900, ix, 24-32.
Also: Papers and addresses (Welch), Balt., 1920, iii, 379-386.
186. Relations of laboratories to public health. Address before the American Public Health Association, at a meeting held in Minneapolis, Minn., October 31, and November 1-3, 1899.
Am. Pub. Health Ass. Rep., 1899, Columbus, 1900, xxv, 460-465. (Reprinted.)
Also: Papers and addresses (Welch), Balt., 1920, i, 615-620.
187. Hemorrhagic infarction of the intestine. Brief report of a case, exhibition of specimen and remarks concerning the etiological factors;

before The Johns Hopkins Hospital Medical Society, Baltimore, January 9, 1899.

(Abstr.) Maryland M. J., Balt., 1899, xli, 38.

188. Thrombosis of the veins of the neck and arm in a case of cardiac disease. Brief report of a case before The Johns Hopkins Hospital Medical Society, Baltimore, February 20, 1899.

Maryland M. J., Balt., 1899, xli, 142.

189. Cavities in the brain produced by *Bacillus aerogenes capsulatus.* (Subjects discussed: Demonstration of microscopical section of emphysematous liver due to postmortem development of *Bacillus aerogenes capsulatus;* Holes in brain as due to postmortem development of gas bacilli.)

Johns Hopkins Hosp. Bull., Balt., 1899, x, 65.

190. The gelatin treatment for aneurism. (Subject discussed: Importance in studying the resistance and number of red blood cells and increase in platelets as well as coagulation time and fibrin content in thrombosis after gelatin injections.)

Johns Hopkins Hosp. Bull., Balt., 1899, x, 96.

Also: Maryland M. J., Balt., 1899, xli, 37.

191. Report of gynaecological cases. Case 3. Excessive growth of fat. (Subject discussed: Favorable prognosis of hysterectomy for uterine cancer due to late period of metastasis of uterine cancer.)

Johns Hopkins Hosp. Bull., Balt., 1899, x, 197.

Also: Maryland M. J., Balt., 1899, xli, 345.

192. A case of haemochromatosis. (Subject discussed: Origin of the pigment in haemochromatosis.)

Johns Hopkins Hosp. Bull., Balt., 1899, x, 213.

Also: Maryland M. J., Balt., 1899, xli, 200.

193. A case of haemochromatosis. The relation of haemochromatosis to bronzed diabetes. (Subject discussed: Is purpura an independent disease?)

Tr. Ass. Am. Physicians, Phila., 1899, xiv, 281.

Also: Maryland M. J., Balt., 1899, xli, 361.

194. On the diplococcoid form of the colon bacillus. (Subjects discussed: Colon bacilli in liver and bile; Absorption of bacteria from gastrointestinal tract and intracellular digestion of these bacteria by liver cells.

Tr. Ass. Am. Physicians, Phila., 1899, xiv, 321-322.

Also: Maryland M. J., Balt., 1899, xli, 363.

1900

195. Venous thrombosis in cardiac disease. Amplification of an address delivered before the Association of American Physicians, Washington, D. C., May 3, 1900.

Tr. Ass. Am. Physicians, Phila., 1900, xv, 441-469. (Reprinted.)

Also: Internat. contrib. med. lit. Festschr., Abraham Jacobi, N. Y., pp. 463-483. (Reprinted.)

Also: Papers and addresses (Welch), Balt., 1920, i, 259-284.

196. In acceptance of a volume of contributions to medical science. (N. T.) Report of remarks made in acceptance of a volume of contributions to medical science upon the occasion of the Twenty-fifth Anniversary of his Graduation, at a dinner at the Maryland Club, Baltimore, May 4, 1900.

Johns Hopkins Hosp. Bull., Balt., 1900, xi, 136-137.

Also: Maryland M. J., Balt., 1900, xliii, 314-319.

Also: Papers and addresses (Welch), Balt., 1920, iii, 351-354.

197. Argument against Senate bill 34, fifty-sixth Congress, first session, generally known as the "Antivivisection Bill." Prepared as an argument against Senate bill 34.

J. Am. M. Ass., Chicago, 1900, xxxiv, 1242-1244; 1322-1327. (Reprinted.)

Also: Papers and addresses (Welch), Balt., 1920, iii, 469-499.

198. Morbid conditions caused by *Bacillus aerogenes capsulatus.* The Shattuck lecture delivered before the Massachusetts Medical Society, Boston, June 12, 1900.

Boston M. & S. J., 1900, cxliii, 73-87. (Reprinted.)

Also: Phila. M. J., 1900, vi, 202-216. (Reprinted.)

Also: Johns Hopkins Hosp. Bull., Balt., 1900, xi, 185-204. (Reprinted.)

Also: Med. Communica. Mass. M. Soc., Bost., 1901, xviii, 253-307. (Reprinted.)

Also: Papers and addresses (Welch), Balt., 1920, ii, 599-636.

199. The material needs of medical education. Address at the opening of the new building of the College of Physicians and Surgeons of Baltimore, December 21, 1899.

J. Alumni Ass. Coll. Phys. & Surg., Balt., 1900, ii, 97-106. (Reprinted.)

Also: Papers and addresses (Welch), Balt., 1920, iii, 63-70.

200. Distribution of *Bacillus aerogenes capsulatus.* (*Bacillus welchi,* Migula.) Abstract of paper presented at the Second Annual Meet-

ing of the American Society of Bacteriologists, Baltimore, Md., December 1900.
J. Bost. Soc. M. Sc., Boston, 1900-01, v, 369-370.
Also: (Abstr.) Centralbl. f. Bakteriol. u. Parasitenk., Jena, 1901, I. Abt., xxix, 442-443.
Also: Papers and addresses (Welch), Balt., 1920, ii, 637.

201. Idiopathic phlegmonous gastritis. (Subject discussed: Brief report of a case of idiopathic phlegmonous gastritis.)
Tr. Ass. Am. Physicians, Phila., 1900, xv, 133.
Also: Papers and addresses (Welch), Balt., 1920, i, 457.

202. Primary echinococcus cysts of the pleura. Pathological report taken from a letter and published in: Primary echinococcus cysts of the pleura. Report of a case of primary exogenous echinococcus cysts of the pleura showing hyaline degeneration of the cuticle without lamellation, with notes from the literature, by Charles Cary and Irving P. Lyon.
Tr. Ass. Am. Physicians, Phila., 1900, xv, 371-373.
Also: Papers and addresses (Welch), Balt., 1920, i, 461-462.

203. On a form of conjugation of the malarial parasite. (Subject discussed: Is conjugation essential to the life history of the organism?)
Johns Hopkins Hosp. Bull., Balt., 1900, xi, 94.

204. Proliferation and phagocytosis. (Subjects discussed: Various stimuli to cell proliferation; Difficulty of decision as to which is the phagocyte, endothelial cell or leucocyte.)
Tr. Ass. Am. Physicians, Phila., 1900, xv, 235.

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205. Opening remarks before the Association of American Physicians, Washington, D. C., April 30, 1901. (Report of remarks.)
Tr. Ass. Am. Physicians, Phila., 1901, xvi, p. XVI-XXII (Minutes). (Reprinted.)
Also: Papers and addresses (Welch), Balt., 1920, iii, 273-279.

206. Laboratory methods of teaching. Report of remarks made before the American Surgical Association at a meeting held in The Johns Hopkins Hospital, Baltimore, May 8, 1901.
Tr. Am. Surg. Ass., Phila., 1901, xix, 219-222.
Also: (Abstr.) Med. News, N. Y., 1901, lxxviii, 795.
Also: Papers and addresses (Welch), Balt., 1920, iii, 71-73.

207. The relation of Yale to medicine. An address delivered at the Two Hundredth Anniversary of the founding of Yale College, Yale University, New Haven, Conn., October 21, 1901.

Yale M. J., N. Haven, 1901-2 viii, 127-158. (Reprinted.)

Also: Science, N. Y. & Lancaster, Pa., 1901, n. s., xiv, 825-840. (Reprinted.)

Also: The record of the celebration of the two hundredth anniversary of the founding of Yale College, etc., (Yale University), N. Haven, 1902, (De Vinne Press, 611 p.) 202-249. (Reprinted in book form; Yale in its relation to medicine, N. Haven, 1902, 47 p., 8°.)

Also: Med. News, N. Y., 1902, lxxx, 1165-1174. (Reprinted.)

Also: Papers and addresses (Welch), Balt., 1920, iii, 243-272.

208. The relations of Hodgkin's disease and tuberculosis. Introductory remarks at meeting of the Laennec Society, Baltimore, December 17, 1901.

(Not published.)

209. Introductory note to Drs. Durham and Myers' report. (Brief tribute to Durham and Myers of the English Commission, who contracted yellow fever while studying the disease, the latter dying from his attack.)

Johns Hopkins Hosp. Bull., Balt., 1901, xii, 48.

210. The principles of pathological histology, by Harvey R. Gaylord and Ludwig Aschoff. (An introduction by Welch.)

Phila., & N. Y., 1901, Lea Brothers & Co., 359 p. 4°.

211. Osteo-fibromyoma of the uterus. Report on a pathological specimen.

In: Osteo-fibromyoma of the uterus, by George B. Johnston.

Am. Gynaec. & Obst. J., N. Y., 1901, xviii, 307-309.

Also: Papers and addresses (Welch), Balt., 1920, i, 432-433.

212. Two examples of Bence Jones' albumosuria associated with multiple myeloma. (Subjects discussed: Possibility that multiple myelomata belong to the class of plasmomata; Brief report of a case of plasmomata of the palpebral conjunctiva.)

Johns Hopkins Hosp. Bull., Balt., 1901, xii, 44-45.

213. The intrinsic blood-vessels of the kidney and their significance in nephrotomy. (Subject discussed: Anastomosis between the renal vessels and the lumbar and ureteral vessels.)

Johns Hopkins Hosp. Bull., Balt., 1901, xii, 216.

214. Rheumatism with fibroid nodules. (Exhibition of a case.) (Subject discussed: Pathology of nodules in rheumatism.)

Johns Hopkins Hosp. Bull., Balt., 1901, xii, 216.

215. Report upon *Bacillus mortiferus.* (Subject discussed: Organism cultivated as identical with one found microscopically in the original liver.)
Johns Hopkins Hosp. Bull., Balt., 1901, xii, 218.

216. Chronic jaundice with xanthoma multiplex. (Subjects discussed: Brief report of a case; Clinical types of the disease; Survey of theories of origin of the xanthoma cells.)
Johns Hopkins Hosp. Bull., Balt., 1901, xii, 220-221.
Also: Maryland M. J., Balt., 1901, xliv, 127.
Also: Papers and addresses (Welch), Balt., 1920, i, 447-448.

217. The parasite of cancer with demonstrations. (Subjects discussed: So-called cell enclosures; Importance of attempts to cultivate parasitic organisms from malignant tumors; Skepticism as to etiological factor of any previously described parasitic bodies.)
Johns Hopkins Hosp. Bull., Balt., 1901, xii, 295-296.
Also: Papers and addresses (Welch), Balt., 1920, i, 534-535.

218. The relation of cholelithiasis to disease of the pancreas and to fat necrosis. (Subject discussed: Readiness with which infection follows obstruction to the outlet of glands.)
Maryland M. J., Balt., 1901, xliv, 35.

219. Experimental yellow fever. (Subject discussed: Tribute to the American soldiers who submitted themselves for experimental inoculation with yellow fever.)
Tr. Ass. Am. Physicians, Phila., 1901, xvi, 71.

220. The nature of internal lesions in death from superficial burns. (Subjects discussed: Destruction of cells by toxin in severe burns; Removal of damaged cells by large endothelial cells.)
Tr. Ass. Am. Physicians, Phila., 1901, xi, 164-165.

1902

221. Virchow. A tribute.
Phila. M. J., Phila., 1902 x, 13. (Reprinted.)
Also: Papers and addresses (Welch), Balt., 1920, iii, 377-378.

222. Crusade of recent years against tuberculosis. Brief report of remarks made before the joint meeting of Maryland Public Health Association, the Medical and Chirurgical Faculty and the Laennec Society, Baltimore, January 27, 1902.
Maryland M. J., Balt., 1902, xlv, 135.

223. The Huxley Lecture. On recent studies of immunity with special reference to their bearing on pathology. Delivered at the opening of the winter session of Charing Cross Hospital Medical School, London, October 1, 1902.

Brit. M. J., Lond., 1902, ii, 1105-1114. (Reprinted.)
Also: Lancet, Lond., 1902, ii, 977-984.
Also: Johns Hopkins Hosp. Bull., Balt., 1902, xiii, 285-299.
Also: Med. News, N. Y., 1902, lxxxi, 721-735. (Reprinted.)
Also: Science, N. Y., & Lancaster, Pa., 1902, n. s., xvi, 804-816; 850-861. (Reprinted.)
Also: Papers and addresses (Welch), Balt., 1920, ii, 359-388.

224. Hypernephroma. Pathological report and remarks.
In: Malignant disease of kidney in children. Report of a case with operation, by J. F. Percy.
Clin. Rev., Chicago, 1902, xvi, 383-385.

225. A clinical study of 135 cases of empyema based upon the bacteriological findings in the exudate. (Subject discussed: Occasional necessity of careful examination morphologically and by inoculation of animals in order to distinguish between streptococcus and the lanceolate coccus.)
Tr. Ass. Am. Physicians, Phila., 1902, xvii, 241.

226. Some rare forms of chronic peritonitis, by Albert G. Nicholls. (Subjects discussed: Diffuse thickened peritoneum associated with carcinoma of stomach and the ovaries; Rich vascularized thin layers of new connective tissue and small haemorrhages and blood pigment on the pelvic peritoneum.)
Tr. Sect. Path. & Physiol. Am. M. Ass., Chicago, 1902, 92-93.

1903

227. Origin and aims of the new Section of Physiology and Experimental Medicine. An address before the Section of Physiology and Experimental Medicine, American Association for the Advancement of Science, Washington, December, 1902—January, 1903.
Proc. Am. Ass. Adv. Sc., Wash., 1903, lii, 529-534. (Reprinted.)
Also: Papers and addresses (Welch), Balt., 1920, iii, 280-283.

228. The pathological effects of alcohol.
In: Physiological aspects of the liquor problem. Bost. & N. Y., 1903, ii, 349-374. (Reprinted.)
Also: Papers and addresses (Welch), Balt., 1920, i, 413-431.

229. Oration on state medicine. [Abstr.]
Indiana M. J., Indianapolis, 1903, xxi, 510-512.

230. Fracastorius: his opinions and influence upon doctrines of infection. Address given at meeting of The Johns Hopkins Hospital Historical Club, November 9, 1903.
(Not published.)

231. State registration of trained nurses. (N. T.) Report of an address delivered before The Johns Hopkins Nurses Alumnae Association upon the occasion of the formation of a state association of trained nurses, Baltimore, December 14, 1903.

Johns Hopkins Nurses Alumnae Mag., Balt., 1903, ii, 155-161.

Also: Proc. Maryland State Ass. Graduate Nurses, Balt., 1903-04, 19-25.

Also: Papers and addresses (Welch), Balt., 1920, iii, 157-162.

232. The bacillus of dysentery, with special reference to its etiological relationship to the summer diarrhoea of children. (Subjects discussed: Need for further study of prevalence, distribution, precise cultural and other characteristics of Shiga group of bacilli; The classification of all forms of dysentery.)

Johns Hopkins Hosp. Bull., Balt., 1903, xiv, 321-322.

Also: Maryland M. J., Balt., 1903, xlvi, 325.

233. The action of alcohol in disease; especially upon the circulation. (Subjects discussed: Animals intoxicated with alcohol as more susceptible to infectious disease; No relation between bacteriolytic power of the blood and the susceptibility to infection; Action of alcohol finally to be interpreted from clinical experience.)

Tr. Ass. Am. Physicians, Phila., 1903, xviii, 423-424.

234. A clinical and pathological study of two cases of splenic anaemia, with early and late stages of cirrhosis (early and late stages of Banti's disease). (Subjects discussed: Theory of lymphocytes; Amoeboid movement of lymphocytes; Frequency of terminal infection in leukaemia; Brief report of primary sclerosis and calcareous degeneration of the portal vein.)

Tr. Ass. Am. Physicians, Phila., 1903, xviii, 554.

Welch, W. H., et al.

235. Report. Introductory chapter to Report of Committee of Fifty on the Physiological and Pathological aspects of the Drink Problem.

In: Physiological aspects of the liquor problem Bost. & N. Y., 1903, i, XI-XXII.

1904

236. Acute miliary tuberculosis, historical note. Given at meeting of the Laennec Society, Baltimore, February 24, 1904.

(Not published.)

237. Present bacteriological knowledge concerning pneumonia. Brief report of remarks made before Medical and Chirurgical Faculty of Maryland, Baltimore, March 18, 1904.

Maryland M. J., Balt., 1904, xlvii, 240.

238. Medicine at the close of the seventeenth century. Address at meeting of The Johns Hopkins Hospital Historical Club, May 23, 1904.
(Not published.)
239. Medicine and the medical faculty. Report of an address delivered upon the occasion of the inaugural ceremonies of President Dabney, University of Cincinnati, Cincinnati, Ohio, November 16, 1904.
Univ. Cincin. Rec., Cincin., 1904-05, i, 48-51.
240. The healing of pulmonary tuberculosis, anatomical condition. Given at meeting of the Laennec Society, November 18, 1904.
(Not published.)
241. Gastric ulcer: etiology and pathogenesis of gastric ulcer; age and sex incidence; etiology of round ulcer. Brief report of remarks made before The Johns Hopkins Hospital Medical Society, Baltimore, December 5, 1904.
Maryland M. J., Balt., 1904-05, xlviii, 64-65.
242. Theory of pulmonary oedema. A letter to S. J. Meltzer in 1904.
In: Edema, a consideration of the physiologic and pathologic factors concerned in its formation (S. J. Meltzer).
Am. Med., Phila., 1904, viii, 195-196. (Reprinted.)
Also: Papers and addresses (Welch), Balt., 1920, i, 36-41.
243. The limitations of urinary diagnosis. (Subject discussed: Inability to construct clinical histories from postmortem appearances and vice versa.)
Johns Hopkins Hosp. Bull., Balt., 1904, xv, 176.
Also: Maryland M. J., Balt., 1904, xlvii, 164.
244. The treatment of delirium tremens and allied conditions. (Subject discussed: Results in animal experimental studies in the pathological effects of alcoholism.)
Johns Hopkins Hosp. Bull., Balt., 1904, xv, 261-262.
245. Analysis of forty-two cases of venous thrombosis occurring in the course of typhoid fever. (Subject discussed: Primary inflammation of the wall of a vein as the starting point for venous thrombosis.)
Tr. Ass. Am. Physicians, Phila., 1904, xix, 172.
246. Some unusual forms of acute myelitis. (Subject discussed: Many reported cases of acute myelitis not true infection from an anatomical standpoint.)
Tr. Ass. Am. Physicians, Phila., 1904, xix, 505.

1905

247. Presentation of William Osler for the honorary degree of doctor of Laws. Report of remarks made upon the presentation of William

Osler for the honorary degree of doctor of laws at the Washington Anniversary Exercises of The Johns Hopkins University, Baltimore, February 22, 1905.
The Sun (morning edition), Balt., Feb. 23, 1905, cxxxi, no. 99, p. 12.

248. Some aspects of medicine in the seventeenth century. Address given at meeting of The Johns Hopkins Hospital Historical Club, Baltimore, March 13, 1905 and April 10, 1905.
(Not published.)

249. Preventive medicine. (Abstr.) Brief report of historical remarks made before the Annual Meeting of the Medical and Chirurgical Faculty of Maryland, Baltimore, April 26, 1905.
Maryland M. J., Balt., 1905, xlviii, 275-276.

250. The life and work of Carl Weigert, with personal reminiscences. Address given at meeting of The Johns Hopkins Hospital Historical Club, Baltimore, December 11, 1905.
(Not published.)

251. Tuberculosis of the urinary apparatus: pathology of kidney tuberculosis; chronic localized renal tuberculosis; source of renal tuberculosis. Brief report of remarks made before the Laennec Society, Baltimore, December 15, 1904.
Maryland M. J., Balt., 1905, xlviii, 69-70.

252. Some recent contributions to the subject of arteriosclerosis. Address at meeting of The Johns Hopkins Hospital Medical Society, Baltimore, December 18, 1905.
(Not published.)

253. Is the Mississippi a source of typhoid infection in Louisiana? A letter to B. A. Colomb in regard to the danger of typhoid fever from the Mississippi River due to numerous sources of contamination from untreated sewage entering the stream; the case of Missouri vs Illinois concerning discharge of the Chicago sewage into the Illinois River.
N. Orl. M. & S. J., 1904-05, lvii, 765-767.

254. The immunization of mice to cancer; pathological changes. (Subject discussed: Histological changes in tumors of mice immunized against cancer.)
Johns Hopkins Hosp. Bull., Balt., 1905, xvi, 147.
Also: Maryland M. J., Balt., 1905, xlviii, 145.

255. History of typhoid fever. (Subject discussed: Some historical factors leading to the separation of typhus and typhoid fever.)
Johns Hopkins Hosp. Bull., Balt., 1905, xvi, 414.

256. Discussion on the papers of Drs. Welch, Richer, Kinghorn, Ravenel, Landis, Baldwin, Allen, Nichols and Trudeau. (Subjects discussed: In regard to some experiments of Trudeau; Method of determining predisposition to tuberculosis, etc.)
Nat. Ass. Study & Prev. Tuberc., Tr., N. Y., 1905, i, 163-164.

257. Examination of the blood in pulmonary tuberculosis, with special reference to prognosis. (Subjects discussed: Increase in mononuclear leucocytes; Blood picture in acute inflammatory diseases, etc.)
Nat. Ass. Study & Prev. Tuberc., Tr. N. Y., 1905, I, 181.

258. A case of lymphatic leukaemia. (Subject discussed: Importance of histological study of lymphatic glands in Hodgkin's disease, lymphatic leukaemia and sarcoma.)
Tr. Ass. Am. Physicians, Phila., 1905, xx, 264.

259. A brief report on research in the writer's laboratory on bacterial toxins and immunity. (Subjects discussed: Objections to the explanation of the phenomena of infection by the application of toxins obtained by culture; Difference between the degree of immunity produced by killed cultures of typhoid bacilli and the immunity produced in diphtheria, tetanus, smallpox, etc.)
Tr. Ass. Am. Physicians, Phila., 1905, xx, 276-277.

260. Peripheral phlebosclerosis. (Subject discussed: Difference between arteriosclerosis and endarteritis obliterans.)
Tr. Ass. Am. Physicians, Phila., 1905, xx, 532.

261. Review of deaths due to cancer during the past 14 years. (Subject discussed: Cause for apparent increase in number of deaths due to cancer in the white race and decrease in the colored race.)
Tr. M. & Chir. Fac. Maryland, Balt., 1905-08, xi, 273.

1906

262. The benefits of the endowment of medical research. An address at the formal opening of the Laboratories of the Rockefeller Institute for Medical Research, New York, May 11, 1906.
Johns Hopkins Hosp. Bull., Balt., 1906, xvii, 247-251. (Reprinted.)
Also: Stud. Rockefeller Inst. M. Research, N. Y., 1907, vi, 26-38. (Reprinted.)
Also: Science, N. Y. & Lancaster, Pa., 1906, xxiv, 6-12. (Reprinted.)
Also: Educational Rev., Rahway, N. J., & N. Y., 1906, xxxii, 217-227. (Reprinted.)
Also: Papers and addresses (Welch), Balt., 1920, iii, 74-82.

263. American Association for the Advancement of Science. (N. T.) Report of address as President, delivered in response to the address of welcome at the 56th meeting of the American Association for the Advancement of Science, Ithaca, New York, June 29, 1906.
Science, N. Y. & Lancaster, Pa., 1906, n. s., xxiv, 37-40.
Also: Proc. Am. Ass. Adv. Sc., Wash., 1906-07, lvi-lvii, 320-323.
Also: Papers and addresses (Welch), Balt., 1920, iii, 284-287.

264. The unity of the medical sciences. An address delivered upon the occasion of the dedication of the new building of the Harvard Medical School, Boston, Mass., September 26, 1906.
Boston M. & S. J., 1906, clv, 367-372. (Reprinted.)
Also: Science, N. Y. & Lancaster, Pa., 1906, n. s., xxiv, 454-461. (Reprinted.)
Also: Detroit M. J., 1906, vi, 372-381.
Also: Johns Hopkins Hosp. Bull., Balt., 1906, xvii, 350-354. (Reprinted.)
Also: Papers and addresses (Welch), Balt., 1920, iii, 305-314.

265. Some experiences with blood cultures in the study of infections. (Subject discussed: Significance of bacteria in the blood.)
Maryland M. J., Balt., 1906, xlxix, 194.

266. Cryptogenetic streptococcus infection with persistent cutaneous eruption, enlargement of the lymphatic glands and fever suggesting syphilis. (Subject discussed: Need for caution in accepting newly described species of streptococci.)
Tr. Ass. Am. Physicians, Phila., 1906, xxi, 377.

1907

267. Position of natural science in education. (N. T.) Report of an address, in response to the address of welcome, as presiding officer of the 57th meeting of the American Association for the Advancement of Science, Columbia University, New York City, December 27, 1906.
Science, N. Y. & Lancaster, Pa., 1907, n. s., xxv, 52-56.
Also: Proc. Am. Ass. Adv. Sc., Wash., 1906-07, lvi-lvii, 617-622.
Also: Papers and addresses (Welch), Balt., 1920, iii, 83-88.

268. Walter Reed. A brief account of Reed's work at The Johns Hopkins University and Hospital.
In: Walter Reed and Yellow Fever [Howard A. Kelly], N. Y., 1907, 63-67.

269. Experience as a sitter for the Sargent Portrait. (N. T.) Report of remarks made upon the occasion of the formal presentation by Mary Garrett of the Sargent's painting of the Four Doctors to the trustees

of The Johns Hopkins University, McCoy Hall, Baltimore, January 19, 1907. (Mr. Royal Cortissoz.)
Johns Hopkins Univ. Circ., Balt., 1907, xxvi, 19-22.
Also: Papers and addresses (Welch), Balt., 1920, iii, 355-357.

270. The relations of physics to medicine. Address given at meeting of The Johns Hopkins Hospital Historical Club, Baltimore, April 8, 1907, and May 13, 1907.
(MS. not published.)

271. The relation of the hospital to medical education and research. Address at the opening of the new Jefferson Medical College Hospital, Philadelphia, June 7, 1907.
J. Am. M. Ass., Chicago, 1907, xlix, 531-535. (Reprinted.)
Also in: Med. Research and Education (Pearce, [et al.]), N. Y. & Garrison, N. Y., 1913, 183-194.
Also: Papers and addresses (Welch), Balt., 1920, iii, 132-141.

272. Some of the conditions which have influenced the development of American medicine, especially during the last century. An address delivered at the Centennial Celebration of the College of Physicians and Surgeons, Columbia University, New York, June 11, 1907.
Columbia Univ. Quarterly Supplement, N. Y., 1907, x, 39-58. (Reprinted.)
Also: Johns Hopkins Hosp. Bull., Balt., 1908, xix, 33-40. (Reprinted.)
Also: Papers and addresses (Welch), Balt., 1920, iii, 288-304.

273. Response as president-elect. Report of remarks as presiding officer of the 57th meeting of the American Association for the Advancement of Science, Columbia University, New York City, December 27, 1907.
Science, N. Y. & Lancaster, Pa., 1907, n. s., xxv, 50-51.
Also: Proc. Am. Ass. Adv. Sc., Wash., 1906-07, lvi-lvii, 616.

274. Lectures on bacteriology, delivered before the second year students of The Johns Hopkins Medical School, Baltimore, October-December, 1908.
(MS. not printed.)

1908

275. Federal regulation of public health. Report of an address delivered before the public health discussion in Section I, at the Annual Meeting of the American Association for the Advancement of Science, Chicago, January 2, 1908.
J. Am. M. Ass., Chicago, 1908, L, 228-229.
Also: (Abstr.) Am. Health, N. Haven & N. Y., 1908, i, 6-8.

276. Medical education in England in 18th and early part of the 19th centuries. Address given at meeting of The Johns Hopkins Hospital Historical Club, January 13, 1908, and February 10, 1908.
(MS. not published.)

277. What may be expected from more effective application of preventive measures against tuberculosis. Report of an address delivered before a public meeting under the auspices of the State Charities Aid Association in cooperation with the State Department of Health, in behalf of a state campaign for the Prevention of Tuberculosis, Albany, N. Y., January 27, 1908.
Albany M. Ann., 1908, xxix, 256-262.
Also: Papers and addresses (Welch), Balt., 1920, i, 632-636.

278. Public health with especial reference to the work of the trained nurse. Report of an address before the Nurses' Alumnae Association, Baltimore, February 4, 1908.
Johns Hopkins Nurses Alumnae Mag., Balt., 1908, vii, 13-21.

279. Robert Koch. A tribute. Report of an address made at a banquet given by the German Medical Society of New York, as an American tribute to Robert Koch, New York City, April 11, 1908.
J. Outdoor Life, Trudeau, N. Y., 1908, v, 165-167.

280. Some sources of infection concerned in the spread of typhoid fever. (Stenographic notes in Minutes of Baltimore City Medical Society, May 19, 1908.)
(Not published.)

281. Opening remarks by the president of the section. Report of remarks of the President made before Section I (Pathology and Bacteriology), of the Sixth International Congress on Tuberculosis, Washington, D. C., September 28, 1908.
Tr. VI. Internat. Cong. Tuberc., Phila., 1908, i, Sect. I, 2-4.

282. Major James Carroll, M. D., U. S. A. (N. T.) Report of an address given at The Johns Hopkins Hospital Historical Club, in memory of Major James Carroll, M. D., U. S. A., Baltimore, October 14, 1907.
Johns Hopkins Hosp. Bull., Balt., 1908, xix, 6-7.
Also: Papers and addresses (Welch), Balt., 1920, iii, 387-390.

283. A consideration of the introduction of surgical anaesthesia. An address delivered at the Massachusetts General Hospital on the Sixty-second Anniversary of Ether Day, Boston, October 16, 1908.
Boston M. & S. J., 1908, clix, 599-604. (Reprinted.)
Also: Papers and addresses (Welch), Balt., 1920, iii, 221-233.

284. Medicine and the university. An address delivered at the Convocation Exercises of the University of Chicago, December 17, 1907.

J. Am. M. Ass., Chicago, 1908, l, 1-7. (Reprinted.)
Also: Science, N. Y. & Lancaster, Pa., 1908, n. s., xxvii, 8-20.
Also: University Rec., Chicago, 1908, xii, 75-86. (Reprinted.)
In: Medical Research and Education (Pearce, [et al.]), N. Y. & Garrison, N. Y., 1913, 165-181.
Also: Papers and addresses (Welch), Balt., 1920, iii, 89-103.

285. The interdependence of medicine and other sciences of nature. Address of the retiring President of the American Association for the Advancement of Science, delivered at the meeting in Chicago, December 30, 1907.
Science, N. Y. & Lancaster, Pa., 1908, n. s., xxvii, 49-64. (Reprinted.)
Also: Nature, Lond., 1908, lxxvii, 283-285.
In: Medical Research and Education (Pearce, [et al.]), N. Y. & Garrison, N. Y., 1913, 143-164.
Also: Papers and addresses (Welch), Balt., 1920, iii, 315-333.

286. Malignant adenoma of the pylorus originating in misplaced pancreatic tissue. Report of a pathological specimen.
In: Operative treatment of cancer of the stomach, with report of six partial gastrectomies, by Joseph H. Branham.
Maryland M. J., Balt., 1908, li, 145.

287. Chronic peritonitis with complete obstruction, caused by numerous constrictions of a previously undescribed character, throughout the intestine. Report on a pathological specimen.
In: Chronic peritonitis with complete obstruction, caused by numerous constrictions of a previously undescribed character, throughout the intestine, by Miles F. Porter, August 14, 1907.
J. Am. M. Ass., Chicago, 1908, li, 719-722.
Also: Papers and addresses (Welch), Balt., 1920, i, 449-456.

288. A case of gas cyst of the intestine. (Subjects discussed: Theories of etiology of gas in these cysts; Relation of *B. aerogenes capsulatus* to gas-cysts of the brain.)
Johns Hopkins Hosp. Bull., Balt., 1908, xix, 177-178.

289. The kern-plasma relation theory. (Subject discussed: Structure and function of cells.)
Johns Hopkins Hosp. Bull., Balt., 1908, xix, 179.

290. Medical education in the United States. (Subject discussed: In regard to the work and recommendations of the council on education of the American Medical Association.)
Johns Hopkins Hosp. Bull., Balt., 1908, xix, 206.

291. Immunity production by inoculation of increasing numbers of bacteria, beginning with one organism: preliminary report. (Subjects discussed: Relationship of dosage of bacteria to infection and individual susceptibility and virulence of the organism; Variation in the strength and duration of immunity with the mode of production.)
Nat. Ass. Study & Prev. Tuberc., Tr. Phila., 1908, iv, 115.

292. The heart in pulmonary tuberculosis. (Subjects discussed: Lesions of the heart favoring pulmonary tuberculosis and those that seem to increase the resistance of the lungs to tuberculosis; Cardiac hypertrophy; Hypoplasia in pulmonary tuberculosis.)
Nat. Ass. Study & Prev. Tuberc., Tr. Phila., 1908, iv, 141-142.

293. The changes in the lungs in systematic blastomycosis as contrasted with those of tuberculosis. (Subject discussed: Brief report of the case in which the first diagnosis of blastomycosis was made in this country.)
Nat. Ass. Study & Prev. Tuberc., Tr., Phila., 1908, iv, 147-149.
Also: Papers and addresses (Welch), Balt., 1920, ii, 641-642.

294. Preliminary report on experimental ligation of the coronary arteries. (Subject discussed: Whether intramuscular branches of the coronary arteries are terminal.)
Tr. Ass. Am. Physicians, Phila., 1908, xxiii, 89.

295. A study of the occurrence and significance of negative results in blood-culture studies. (Subject discussed: Frequency of the accidental presence of bacteria in the blood as compared with true septicaemia.)
Tr. Ass. Am. Physicians, Phila., 1908, xxiii, 148.

296. Thrombosis of the superior vena cava complicating Grave's disease. (Subject discussed: Cardiac complications in Grave's disease as a factor in production of thrombosis of veins of neck and upper extremities associated with cardiac disease.)
Tr. Ass. Am. Physicians, Phila., 1908, xxiii, 153-154.

297. The pathological changes in the thyroid gland, as related to the varying symptoms in Grave's disease. Based on the pathological findings in 294 cases. (Subjects discussed: Value of the combination of pathological and clinical aspects of Grave's disease: Thyroid hypertrophy in dogs.)
Tr. Ass. Am. Physicians, Phila., 1908, xxiii, 576.

1909

298. Report of a commission on certain features of the federal meat-inspection regulations. (William H. Welch, Chairman.)
In: Rep. Bureau Animal Indust., 1907, Wash., 1909, 361-373.

299. Introductory remarks, the Laennec Society, its history and its aims. Address given at meeting of the Laennec Society, January 21, 1909. (Not published.)

300. Dedication of Osler Hall. Report of remarks made at the dedication of Osler Hall, before the Medical and Chirurgical Faculty of the State of Maryland, Baltimore, May 13, 1909.
Bull. Med. & Chir. Fac. Maryland, Balt., 1908-09, i, 241-242.
Also: Papers and addresses (Welch), Balt., 1920, iii, 358-359.

301. Considerations relating to the control of tuberculosis. (N. T.) Report of an address delivered before the National Association for the Study and Prevention of Tuberculosis, Washington, D. C., May 14, 1909.
Nat. Ass. Study & Prev. Tuberc., Tr., Phila., 1909, v, 34-36.
Also: Papers and addresses (Welch), Balt., 1920, i, 637-639.

302. Studies in rabies. In collected writings of Nathaniel Garland Keirle. Testimonial ed. (Introduction [Brief biographical notes on Nathaniel Keirle].)
Balt., 1909, The Lord Baltimore Press, 386 p., 8°.

303. In regard to the pure food and drugs bill. Letter to the Medical and Chirurgical Faculty of Maryland, Baltimore, December 14, 1909.
Bull. Med. & Chir. Fac. Maryland, Balt., 1909-10, ii, 148-149.

304. Investigations concerning Rocky Mountain fever. (Subject discussed: Considerations concerning the organism of Rocky Mountain fever.)
Johns Hopkins Hosp. Bull., Balt., 1909, xx, 152.

305. Intestinal obstruction: an anatomical study. (Subject discussed: In regard to the effects produced at different levels of intestinal obstruction.)
Johns Hopkins Hosp. Bull., Balt., 1909, xx, 185.

306. Tuberculosis of the liver. (Subjects discussed: First description of tuberculosis of liver by Weigert; In regard to the question as to the type of tubercle bacillus in tuberculosis of the liver.)
Johns Hopkins Hosp. Bull., Balt., 1909, xx, 294.

307. Marmorek's serum in the treatment of pulmonary tuberculosis. (Subject discussed: Accidental amount of tuberculin as the only factor of value in Marmorek's serum.)
Johns Hopkins Hosp. Bull., Balt., 1909, xx, 295.

308. The influence of the ingestion of dead tubercle bacilli upon infection. (Subject discussed: In regard to lack of any authenticated case of pulmonary tuberculosis due to bovine tubercle bacilli.)
Tr. Ass. Am. Physicians, Phila., 1909, xxiv, 144.

1910

309. The recent anniversary celebrations of the Universities of Leipzig and Geneva. Address given at meeting of The Johns Hopkins Hospital Historical Club, Baltimore, January 10, 1910.
    (Not published.)
310. The medical curriculum. Report of an address delivered before the Association of American Colleges, Baltimore, March 21, 1910.
    Bull. Am. Acad. M., Easton, Pa., 1910, xi, 720-726.
    Also: (Abstr.) J. Am. M. Ass., Chicago, 1910, liv, 1332.
    Also: Papers and addresses (Welch), Balt., 1920, iii, 104-108.
311. In acceptance of a medallion. (N. T.) Report of remarks made extemporaneously at a dinner given in his honor, Baltimore, April 2, 1910.
    In: In Honour of William H. Welch, Balt., 1910, The Lord Baltimore Press, 40-46.
    Also: (Abstr.) J Am. M. Ass., Chicago, 1910, liv, 1221.
    Also: Papers and addresses (Welch), Balt., 1920, iii, 360-364.
312. Importance of uncinariasis. Report of introductory remarks to a symposium on Uncinariasis made before the Medical and Chirurgical Faculty of Maryland, Baltimore, April 27, 1910.
    J. Am. M. Ass., Chicago, 1910, liv, 1719-1720.
313. Remarks at exercises commemorative of the life and work of Isabel Hampton Robb, held at the Nurses' Home of The Johns Hopkins Hospital, Sunday, May 8, 1910.
    Johns Hopkins Nurses Alumnae Mag., Balt., 1910, ix, 60-61.
314. Fields of usefulness of the American Medical Association. President's address delivered at the Sixty-first Annual Session of the American Medical Association, St. Louis, June 7, 1910.
    J. Am. M. Ass., Chicago, 1910, liv, 2011-2017.
    Also: Papers and addresses (Welch), Balt., 1920, iii, 334-350.
315. Organization in medicine. Brief report of remarks made at the One Hundred Forty-fourth Annual meeting of the Medical Society of New Jersey, Atlantic City, June 28, 1910.
    (Abstr.) J. Am. M. Ass., Chicago, 1910, lv, 527.
316. Child welfare. (N. T.) Report of an address delivered before the American Association for the Study and Prevention of Infant Mortality, Baltimore, November 9, 1910.
    Tr. Am. Ass. Study & Prev. Inf. Mortal., Balt., 1910, i, 51-56.
    Also: [Abstr.] J. Am. M. Ass., Chicago, 1910, lv, 2090.
    Also: Papers and addresses (Welch), Balt., 1920, i, 655-659.

317. Municipal, state and federal prevention of infant mortality. Report of an address delivered before the American Association for the Study and Prevention of Infant Mortality, Baltimore, November 10,1910.
Tr. Am. Ass. Study & Prev. Inf. Mortal., Balt., 1910, i, 90-93.
Also: [Abstr.] J. Am. M. Ass., Chicago, 1910, lv, 2258-2259.

318. In regard to credit for creation of the Yellow Fever Commission. To the editor of the American Medical Journal, April, 1910.
J. Am. M. Ass., Chicago, 1910, liv, 1326.

319. Conditions inducing acapnia: a phase of the shock problem. (Subject discussed: As to the old surgical custom of forced respiration before minor surgical operation as a means to produce lessened sensibility to pain.)
Johns Hopkins Hosp. Bull., Balt., 1910, xxi, 51.

320. A season's experience with prophylactic vaccination against typhoid. (Subject discussed: Differences between typhoid and smallpox vaccination.)
Johns Hopkins Hosp. Bull., Balt., 1910, xxi, 52.

321. Relative importance of the human and bovine types of tubercle bacillus in human tuberculosis. (Subjects discussed: Distinctness of bovine from human type of tubercle bacillus; Tuberculous meningitis as not originating from the alimentary tract.)
Johns Hopkins Hosp. Bull., Balt., 1910, xxi, 123.

322. On the relation of combined intoxication and bacterial infection to necrosis of the liver, acute yellow atrophy, and cirrhosis. (Subjects discussed: Colon bacilli in liver and gall-bladder; Experimental bacilli carriers; Inability to produce experimental cirrhosis of the liver; Origin of newly formed bile ducts.)
Tr. Ass. Am. Physicians, Phila., 1910, xxv, 170.

1911

323. Is animal experimentation cruel?
Leslie's Weekly, N. Y., 1911, cxii, 259.
Also: Papers and addresses (Welch), Balt., 1920, iii, 500-502.

324. The influence of Koch and his students. Address given at meeting of the Laennec Society, commemorative of Robert Koch, Baltimore, March 27, 1911.
(Not published.)

325. Christian Archibald Herter. A minute prepared for the board meeting of the Rockefeller Institute, New York, April 8, 1911.
Official Copy of Minutes of Board of Rockefeller Inst., N. Y., 1911.
Also: Johns Hopkins Hosp. Bull., Balt., 1911, xxii, 161.

Also: Cyclopedia Am. Med. Biography (Kelly), Phila., 1912, i, 402-403.

326. Medicine at the time of Jenner. Address given at meeting of The Johns Hopkins Hospital Historical Club, Baltimore, April 10, 1911.
(Not published.)

327. Francis Donaldson. (N. T.) Report of remarks made at the presentation of the portrait of Francis Donaldson to the Medical and Chirurgical Faculty of Maryland, Baltimore, April 25, 1911.
Bull. Med. & Chir. Fac. Maryland, Balt., 1911, iii, 174-179.
Also: Papers and addresses (Welch), Balt., 1920, iii, 391-396.

328. John Shaw Billings. Report of remarks made at a special memorial meeting of The Johns Hopkins Hospital Medical Society, Baltimore, May 26, 1913.
Johns Hopkins Hosp. Bull., Balt., 1914, xxv, 251-253.
Also: Papers and addresses (Welch), Balt., 1920, iii, 400-403.

329. The American Medical Association. Report of an address delivered at a banquet and reception to President Taft and invited guests, given by the Medical Club of Philadelphia, May 4, 1911.
J. Am. M. Ass., Chicago, 1911, lvi, 1401-1402. (Reprinted.)

330. The significance of the great frequency of tuberculous infection in early life for prevention of the disease. Report of an address of the President at the Seventh Annual Meeting of the National Association for the Study and Prevention of Tuberculosis, Denver, Col., June 20-21, 1911.
Nat. Ass. Study & Prev. Tuberc., Tr. Phila., 1911, vii, 17-28. (Reprinted.)
Also: Papers and addresses (Welch), Balt., 1920, i, 440-443.

331. The retiring president's address at the 62d Annual Meeting of the American Medical Association, Los Angeles, June 26 to July 1, 1911. (Brief remarks in regard to some activities of the American Medical Association during the year. Suggestion as to suitable commemoration of medical work in Panama Canal Zone; also to appointment of a medical board to advise with Red Cross in time of war.)
N. York M. J. (etc.), 1911, xciv, 37-38.

332. The relation of sewage to disease. Address at meeting of The Johns Hopkins Hospital Medical Society, Baltimore, October 16, 1911.
(Not published.)

333. Gas cysts of the intestine. Pathological Report.
In: Congenital mucoid multicystic tumor of the small intestine. (H. W. Longyear.)
Am. J. Obstetrics, N. Y., 1911, lxiv, 777-778.

334. (1) Syringo cystoma. (Pathological report not previously published.) (2) Oidiomycosis, with demonstration of sections. (Pathological report not published.) The Johns Hopkins Hospital Medical Society, Baltimore, November 6, 1911.

335. Control of bovine tuberculosis. (Subjects discussed: Koch's work on bovine tuberculosis; Control of bovine tuberculosis.)
Nat. Ass. Study & Prev. Tuberc., Tr., Phila., 1911, vii, 367-370, 374.
Also: Papers and addresses (Welch), Balt., 1920, i, 651-654.

336. Some remarks on the mode of infection and of dissemination of tuberculosis in man based on anatomical investigation. (Subject discussed: Mode of infection and of dissemination of tuberculosis in man.)
Nat. Ass. Study & Prev. Tuberc., Tr., Phila., 1911, vii, 409-411.
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337. Advantages to a charitable hospital of affiliation with a university medical school. Address delivered at the Forty-Third Anniversary of the Presbyterian Hospital in New York City, December 2, 1911.
Survey, N. Y., 1912, xxvii, 1766-1770. (Reprinted.)
Also: Papers and addresses (Welch), Balt., 1920, iii, 146-152.

338. Bright as a pathologist. Address given at meeting of The Johns Hopkins Hospital Historical Club, Baltimore, February 12, 1912.
(Not published.)

339. The hospital in relation to medical science. Report of remarks made by invitation at the Opening of the Section on Hospitals of the American Medical Association, Atlantic City, June, 1912.
J. Am. M. Ass., Chicago, 1912, lix, 1667-1668.
Also: Papers and addresses (Welch), Balt., 1920, iii, 142-145.

340. Testimony before the 27th Session of the Pennsylvania State Vaccination Commission, Philadelphia, November 22, 1912. (To be published in the Minutes of Proceedings and Evidence of the Pennsylvania State Vaccination Commission, 27th Session, 1912.)
(MS. not published.)

341. Exhibition of sections of *Xanthoma tuberosum multiplex.* The Johns Hopkins Hospital Medical Society, Baltimore, May 6, 1912.
(Not published.)

342. Urgent needs in state and national legislation. (Subject discussed: Need for greater state and national public health activity and for a national department of public health.)
Bull. Med. & Chir. Fac. Maryland, Balt., 1911-12, iv, 135-137.

343. Discussion on papers of Mr. Hoffman, Dr. King, Dr. Vogeler, Prof. Fisher, Dr. Knoff and Dr. Sachs. (Subjects discussed: Accurate knowledge as to the cause and mode of spread of tuberculosis as a prerequisite basis for a definite programme for its prevention; Tuberculosis in early life; Protective value of a slight infection of tuberculosis; Whether tuberculosis in later life is a renewed infection or reactivity of an early infection.)
Nat. Ass. Study & Prev. Tuberc., Tr., Phila., 1912, viii, 171-173.

344. A contribution to the symptomatology of thrombophlebitis in typhoid fever. (Subjects discussed: History of name thrombophlebitis; As to frequency of the occurrence of small thrombi without symptoms.)
Tr. Ass. Am. Physicians, Phila., 1912, xxvii, 234.

345. Hospitals and typhoid carriers. (Subject discussed: Report of experimental production of typhoid bacilli carriers twenty years previously.)
Tr. Ass. Am. Physicians, Phila., 1912, xxvii, 366.

346. Fatal postoperative embolism. (Subject discussed: Question as to whether some cases of fatal postoperative embolism attributed to cardiac thrombi might not be due to an overlooked large clot washed out from an extremity.)
Tr. Ass. Am. Physicians, Phila., 1912, xxvii, 449-450.

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347. Vaccination against smallpox. Address at meeting of The Johns Hopkins Hospital Medical Society, Baltimore, February 7, 1913.
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Welch, W. H., Mitchell, S. W., Osler, Sir W. (et al.).

348. John Shaw Billings: memorial meeting in honor of John Shaw Billings. An address delivered at the memorial meeting in honor of the late John Shaw Billings, held in the New York Public Library, New York City, April 25, 1913.
Bull. N. Y. Public Library, N. Y., 1913, xvii, 511-535. (Reprinted.)
Also: (Abstr.) Library J., N. Y., 1913, xxxviii, 334-338.
Also: Papers and addresses (Welch), Balt., 1920, iii, 397-400.

349. Remarks at the Ninth Triennial Session of the Congress of American Physicians and Surgeons, held at Washington, May 6 and 7, 1913. (Brief remarks of appreciation of the success of the congress.)
Tr. Cong. Am. Phys. & Surg., N. Haven, 1913, ix, 104.

350. The history of the medical society. Address at meeting of The Johns Hopkins Hospital Medical Society, Baltimore, November 3, 1913.
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351. The Pennsylvania State Vaccination Commission. Report and dissenting reports. Brief report of testimony of Dr. William H. Welch before the Pennsylvania State Vaccination Commission, Philadelphia, November 22, 1912.
Pennsylvania State Vacc. Com. Rep., Phila., 1913, 15, 65, 66, 80, 181, 182, 183, 188, 192, 193, 194, 217, 218, 220.

352. Historical significance of pathological anatomy for the science and art of medicine as suggested by a collection of books. Report of an address delivered upon the occasion of the presentation of the Ernst Ziegler Library to the Medical Department of the University of Pittsburgh, University Club of Pittsburgh, December 5, 1913.
(MS. not published.)

353. Periosteal round-celled sarcoma of the femur; involving two-thirds of the shaft, with very extensive multiple metastases—apparently cured by the mixed toxine of erysipelas and *Bacillus prodigiosus.* (Subject discussed: Report of microscopical examinations of sarcoma and epithelioma from this case, together with remarks as to theories in regard to their formation.)
Tr. Am. Surg. Ass., Phila., 1913, xxxi, 301-302.

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354. Present position of medical education, its development and great needs for the future. [N. T.] Report of an address at the installation of Dr. Christian R. Holmes as Dean of the University of Cincinnati Medical College, January 16, 1914.
Lancet-Clinic, Cincin., 1914, cxi, 104-110.
Also: Papers and addresses (Welch), Balt., 1920, iii, 111-118.

355. Increased opportunities of the University of Cincinnati for service to the community and state. (N. T.) Report of remarks made at banquet given in honor of Dr. William H. Welch and visiting delegates from educational institutions, to the Cincinnati Conference on Pre-medical Education, Cincinnati, January 17, 1914.
Lancet-Clinic, Cincin., 1914, cxi, 111-112.

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Lancet-Clinic, Cincin., 1914, cxi, 117-118.
Also: Papers and addresses (Welch), Balt., 1920, iii, 109-110.

357. S. Weir Mitchell, physician and man of science. An address delivered at a joint meeting of the College of Physicians of Philadelphia, the American Philosophical Society, the University of Pennsylvania, the

Library Company of Philadelphia, the Jefferson Medical College and the Academy of Natural Sciences, in memory of Silas Weir Mitchell, Philadelphia, March 31, 1914.

In: S. Weir Mitchell, M. D., LL. D., F. R. S., 1829-1914. Memorial addresses and resolutions. Phila., 1914, 99-127.

Also: Papers and addresses (Welch), Balt., 1920, iii, 408-418.

358. Twenty-fifth anniversary of The Johns Hopkins Hospital, 1889-1914. Report of an address upon the occasion of the celebration of the Twenty-fifth Anniversary of The Johns Hopkins Hospital, Baltimore, October 5, 1914.

Johns Hopkins Hosp. Bull., Balt., 1914, xxv, 363-366.

Also: Papers and addresses (Welch), Balt., 1920, iii, 20-25.

359. Formal opening of the Peter Bent Brigham Hospital. Report (uncorrected) of an address delivered at the formal opening of the Peter Bent Brigham Hospital, Founders day, Boston, November 12, 1914.

Peter Bent Brigham Hosp. Pamphlet, Bost., 1914, 8-12.

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360. The life and letters of Nathan Smith, M. B., M. D., by Emily A. Smith. Introduction to the memorial volume.

New Haven, 1914, Yale Univ., 201 p., 8°.

Also: Papers and addresses (Welch), Balt., 1920, iii, 404-407.

361. The persistence of active lesions and spirochaetes in the tissues of clinically inactive or "cured" syphilis. (Subject discussed: Question reinfection with syphilis in cured syphilis.)

Tr. Ass. Am. Physicians, Phila., 1914, xxix, 429.

362. A differential study of coccidoidal granuloma and blastomycosis. (Subjects discussed: First cases of blastomycosis diagnosed in this country; Localization of this disease in Joaquin and Sacramento Valleys and in middle west.)

Tr. Ass. Am. Physicians, Phila., 1914, xxix, 650.

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Med. Rec., N. Y., 1915, lxxxvii, 245-246.

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